

Collapsed Structure Search and Rescue Course



Instructor's Workbook

Name:

Rev. March 2002



OFFICE OF U.S. FOREIGN
DISASTER ASSISTANCE



MIAMI - DADE FIRE
RESCUE DEPARTMENT

1

Course Introduction

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will become familiar with:

1. Names and background information of the course coordinator, instructors, assistants, support staff and the other participants.
2. The following aspects of the course:
 - Expectations
 - Purpose
 - Objectives
 - Methodology
 - Testing
 - Materials
 - Logistics and Agenda
 - Course overview and its relation to the OFDA First Responder Program.





1. Getting to Know Each Other

The Course Coordinator and instructors will conduct an exercise so that you may become familiar with the other participants in the course and become familiar with some of the tools you will be using throughout.

2. Participants' Expectations

The purpose of this short exercise is to find out what your expectations of the Collapsed Structure Search and Rescue Course are – knowledge you hope to gain, skills you hope to acquire, etc.



3. Course Purpose

The purpose of the CSSR Course is **to train the participant in the techniques and methods necessary for searching, locating, stabilising, and extricating victims trapped in collapsed structures, using the safest and most appropriate procedures for the rescuer as well as the victim.**

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3.1 Performance Objectives

Upon completing the CSSR Course, you, as part of a team of 10-12 members, will be able to:

Step 1. Complete the correct and necessary actions upon arriving at the scene and before initiating a search.

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Step 2. Apply the learned search techniques to a simulated victim.

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Step 3. Gain access to a selected void space to locate two simulated victims, using four basic techniques (rubble removal, shoring, penetration and lifting).

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Step 4. Correctly assess, stabilise and extricate a simulated patient.

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To accomplish the above objectives, each group will work through three consecutive simulated scenarios in the Final Practical Examination. Each group will be assigned a full complement of tools and equipment for a CSSR team. All groups must complete all three scenarios within 9 hours or less, using the techniques and procedures taught in this course.



3.2 Instructional Objectives

Upon completing the CSSR Course, you will be able to:

1. Describe how to organize and start a CSSR operation.

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2. Describe and procedure to classify a collapsed structure and the building marking system.

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3. List the safety precautions that must be followed in a CSSR operation.

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4. Describe the methods for locating void spaces and the steps for locating possible victims.

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5. Name and describe the use and maintenance of the tools, equipment and accessories used in a CSSR operation.

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6. List and describe the basic techniques for penetrating a collapsed structure and gaining access to the patient.

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7. Describe pre-hospital treatment for one or more trapped patients in a collapsed structure.

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Each lesson will introduce its own corresponding training objectives.



4. Course Materials

4.1 Participant Workbook (WB)

- The Participant Workbook is your own personal property and you need to keep it safe. Write your name in magic marker on the cover sheet in the box.

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- We have ample space for you to take notes in order to reinforce the material you are learning. All the material you will be tested on will be drawn directly from the workbook, including some of the spaces you fill in.

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- Check your workbook to make sure it is complete and that no pages are missing.

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4.2 Reference Material (RM)

- Generally, each lesson has its own reference material, which you should study in order to complement the lecture.
- You will also receive a glossary and bibliographic references as part of the reference material.

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4.3 Pre-Work

The Pre-Work, which you should have received and completed before coming to this course, serves to establish a common level of knowledge among all participants. It is intended to make you familiar with all the basic concepts, tools and materials that will be used throughout the course.

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4.4 Handouts

You will be receiving handouts occasionally from your instructors for exercises, assignments, etc.



5. Participant Equipment

You should have brought with you to the course a set of personal protective equipment and other work equipment and materials, as indicated:

Required Equipment

- Hardhat (industrial or fire-fighter)
- Eye protection
- Ear protection
- Safety steel-toe boots
- Safety whistle
- Knee pads
- Work gloves
- Work clothes
- Cap or hat
- Canteen or water bottle, minimum 1-litre capacity
- Waterproof flashlight (mounted or hand-held) with spare batteries

Optional

- Overalls or jumpsuit
- Sunscreen lotion
- Insect repellent
- Raincoat or poncho

Other Required Materials

- 2 passport-sized pictures (for the class directory)
- Work uniform or formal clothes for the opening and closing ceremonies

6. Course Methodology

The course methodology is highly participatory and allows constant interaction and feedback between the instructors and participants. You will be required to gain some background knowledge as well as acquire manual skills. Objectives are clearly stated at the beginning of each lesson.

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7. Evaluation System

You will be evaluated in this course using two methods:

- a. **Lesson Post-Tests:** You will take a written post-test (self-test) every evening on the lesson(s) that you took that day. Questions may be in the form of short answer, multiple choice, true/false, fill-in-the-blank or matching. You may also be asked to draw or complete a graphic or sign. These post-tests will be reviewed the next morning.

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- b. **Practical Evaluations,** which will be given in lessons with a performance component. Duration will depend on complexity and number of tasks.

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Scoring System

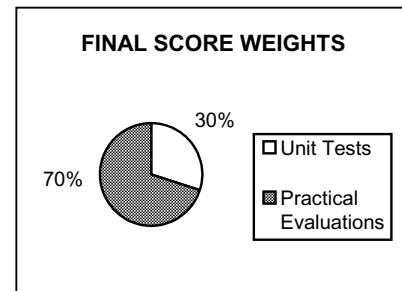
POST-TESTS

Lesson Post-Tests: The minimum passing score on post-tests is 70 percent. All lessons except 1 and 12 will have a post-test. The total sum of the post-test scores for all lessons will count toward 30 percent of your final score for the course.

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PRACTICAL EVALUATIONS

Practical Evaluations: Lessons with a performance component will have a practical evaluation afterwards. Practical evaluations are scored as Pass or No-Pass, based on your performance of tasks and attention to safety. If you receive a No-Pass score on a Practical Evaluation, you will be allowed to take one make-up per Practical Evaluation. Practical evaluations as a whole (all lessons) count toward 70 percent of your final score for the course.



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Non-Passing Scores: If you are unable to obtain a passing score on a Post-Test or a Practical Evaluation, you will not be eligible to participate in the Final Practical Evaluation. In such case, you may continue to participate in the remainder of the course at your choosing. Should you choose to continue participating, you will receive a **Letter of Attendance** for the course, after completing all lessons.

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The **FINAL PRACTICAL EVALUATION** consists of a simulated CSSR incident. This is a pass or fail evaluation **only**. There will be no make-up for the Final Practical. It is divided into three phases for a total duration of nine (9) hours. You can find a more complete description in Lesson 12.

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After successfully completing all course requirements, you will receive a **Certificate of Completion**. This Certificate will state that you have successfully achieved all lesson objectives and completed all tests, practices and evaluation criteria.

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See the CSSR Evaluation Chart below.

| CSSR Evaluation Chart | | |
|------------------------------|--|--|
| Lesson Number | Lesson Post-Tests These will be scored. Minimum 70 percent. | Practical Evaluations. All must receive passing score to complete course. |
| 1 | Course Introduction (No Test) | |
| 2 | Organising and Starting a CSSR Operation | |
| 3 | Structures, Materials and Damage Types | |
| 4 | Structural Triage and the INSARAG Building Marking System | |
| 5 | Operational Safety | |
| 6 | Search and Location Techniques | Search and Location Techniques |
| 7 | Tools, Equipment and Accessories | Using Tools, Equipment and Accessories – Four Stations |
| 8 | Rescue Techniques | Breaking and Breaching Materials – Four Stations |
| 9 | Shoring Techniques | Building Shores – Four Stations |
| 10 | Lifting and Stabilising Loads | Cribbing, Using the Come-Along and Hydraulic Jack – Four Stations |
| 11 | Pre-Hospital Treatment | |
| 12 | | FINAL PRACTICAL EXERCISE |



8. Course Schedule and Attendance

The rules for attendance and participation are as follows:

- Participation in all classes and course activities is mandatory.
- Punctuality – promotes mutual respect and responsibility among participants

Absences and tardiness: Tardiness and missing classes is not acceptable. Only under very special circumstances will an exception be made for one late arrival, to a maximum of 15 minutes. Missing a class or arriving late for no special reason will disqualify you from passing the course.

Only in the case of real emergencies will interruptions to the course be permitted. Telephone calls will be handled by administrative personnel, who will take messages for all course participants.

Participation in all course activities (lectures, practical exercises, and evaluations) is MANDATORY.

9. Participant Feedback

Daily feedback for individual lessons: At the end of each day's classes, there will also be a short, verbal feedback session to capture the strengths of the course and those aspects needing improvement. We will also ask you to fill out the **Lesson Evaluation Form** at the end of each lesson.

Overall course feedback. Once you have completed all lessons and the Final Practical Evaluation, we will ask you to please complete the overall course feedback. We highly value your comments, as they will greatly assist us in improving the course for the future.

10. Required Forms

If you have not already done so, please make sure you have completed and turned in the following CSSR Course forms, which can be found at the end of this lesson:

- Course Registration Form
- Health and Dietary Requirements Form
- Liability Release Form — you must complete this form and turn it in during this lesson in order to continue with the course.



11. Facilities and Ground Rules

House Rules

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Classroom Etiquette

- Smoking is prohibited inside any building; you will be able to smoke outside during breaks.
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- No eating or drinking in the classroom (this may be modified by the course coordinator to allow drinking tea or coffee, etc.).
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- Interruptions will only be permitted for emergencies. The administrative staff will post messages, which you can retrieve during breaks. Mobile phones and beepers must be turned off or set to silent/vibrate mode.
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Meals

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Housing and Expenses

Covered expenses

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Uncovered expenses.....

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Travel: Reservations, confirmations, itineraries, changes, should be directed to administrative staff.

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Safety:

- Take note of emergency procedures, classroom evacuation, emergency exits:

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- Location of safety areas in the facilities, meeting points, etc.:

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- Location of the first aid kit and its contents:

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- Emergency phone numbers, other:

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Optional Activities

Check with administrative personnel regarding tourist or social activities, transportation, etc.

12. “File”

We will post a blank flipchart labelled “File” on one of the walls. We will use it to record questions and issues that will need to be clarified in later lessons or in the general review at the end of the course. You can also write down your questions here for future reference:

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Collapsed Structure Search and Rescue Course

Lesson Evaluation for Participants

Do not write your name on this form. Please complete a copy of this form at the end of every lesson.

Your evaluations are very valuable toward improving the course. For ratings, please use a scale system from 1 to 7, as follows:

| | | | | | | |
|----------------|-----------|--------------------|--------------|-----------|----------------|----------------|
| 1 Very poor | 2 Poor | 3 Below Average | 4 Average | 5 Good | 6 Very Good | 7 Excellent |
|----------------|-----------|--------------------|--------------|-----------|----------------|----------------|

Course Location: _____ **Date:** _____

| | | |
|---|---|--------------------|
| Please fill in the required information. | Lesson Number | Lesson Name |
| | Instructor's Name | |
| Use a scale from 1 to 7 as described above to rate the various lesson components. | Lesson Rating (rate 1 to 7) | |
| | Content _____ Instructor _____ Method _____ Workbook _____ Interaction _____ | |
| Mark your selection with an "X" | Instruction Level (mark with an "X") | |
| | Appropriate _____ Too basic _____ Too advanced _____ | |
| | Duration (mark with an "X") | |
| | Appropriate _____ Too short _____ Too long _____ | |
| | Usefulness | |
| | Was this lesson useful to you? Yes _____ No _____ | |
| Rate from 1 to 7 | Overall Lesson Rating | |
| Taking all the above into consideration, I rate this lesson: _____ | | |
| If you need additional space, please use the back of the sheet. | Comments and Observations | |

Thank you for your help. Your input is valuable. Please turn in this completed form to the instructor.

COLLAPSED STRUCTURE SEARCH AND RESCUE COURSE

Participant Course Evaluation



<<Location>>

_____, 2001

Dear Participant: This course evaluation is a vital part of monitoring the First Responder Training Program. Your comments are valuable and will help us to refine and improve the CSSR Course. Please answer this anonymous and confidential questionnaire as carefully as possible. Use an extra sheet if necessary.

Please fill in this form at the end of the course. Fill in the rating column using a scale from 1 to 7, as follows:

| | | | | | | |
|----------------|-----------|--------------------|--------------|-----------|----------------|----------------|
| 1 Very poor | 2 Poor | 3 Below Average | 4 Average | 5 Good | 6 Very Good | 7 Excellent |
|----------------|-----------|--------------------|--------------|-----------|----------------|----------------|

| Overall Course Evaluation | | | |
|---------------------------------|--------------|----------|-------------------|
| Course Component | Rating (1-7) | Comments | |
| | | Positive | Needs Improvement |
| Quality of classroom facilities | | | |
| Pre-Work | | | |
| Participant's Workbook | | | |
| Lesson Sequence | | | |

| Overall Course Evaluation | | | |
|-------------------------------------|--------------|----------|-------------------|
| Course Component | Rating (1-7) | Comments | |
| | | Positive | Needs Improvement |
| Group activities | | | |
| Course method | | | |
| Visual aids | | | |
| Reaching lesson objectives | | | |
| Instructors as a team | | | |
| Applicability of Final Presentation | | | |
| Relevance of Course to your work | | | |

Participant Course Evaluation (cont'd.)

General Questions

1. What is your overall opinion of the **difficulty level** of the CSSR Course?

☐ Too advanced
 ☐ Appropriate
 ☐ Too basic

Please tell us why: _____

2. What is your opinion of the course **duration**?

☐ Too short
 ☐ Appropriate
 ☐ Too long

Please tell us why: _____

3. Did the CSSR Course meet your **personal expectations**?

☐ Yes
 ☐ No

Please tell us why: _____

4. From an **overall** point of view, how would you rate the CSSR Course? (Circle one, please.)

| | | | | | | |
|-----------|------|---------------|---------|------|-----------|-----------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Very poor | Poor | Below Average | Average | Good | Very Good | Excellent |

Additional comments or suggestions regarding the CSSR Course you would like to add:



**Disaster Preparedness and Response Program
USAID/OFDA ■ Miami-Dade Fire Rescue**

**Collapsed Structure Search and Rescue (CSSR) Course
Course Registration Form**

COURSE LOCATION

COURSE DATES

START:

END:

PARTICIPANT'S FULL NAME

PASTE
PHOTO
HERE

DATE OF BIRTH

Month / Day / Year

SEX

☐ MALE ☐ FEMALE

HOME ADDRESS

WORK ADDRESS

HOME TELEPHONE:

HOME FAX:

WORK TELEPHONE:

WORK FAX:

PERSONAL E-MAIL ADDRESS

WORK E-MAIL ADDRESS

PRESENT POSITION (JOB/TITLE/RANK)

SCHOOLING COMPLETED

☐ PRIMARY ☐ SECONDARY ☐ UNIVERSITY

TEACHING EXPERIENCE

☐ NO ☐ YES HOW LONG? _____

EXPERIENCE IN EMERGENCY SERVICES

☐ FIRST AID

☐ FIRE FIGHTING

☐ TRANSPORTATION

☐ EQUIPMENT MAINTENANCE

☐ EMERGENCY MEDICAL SERVICES

☐ GENERAL SERVICES

☐ VEHICLE RESCUE

☐ CONFINED SPACE RESCUE

☐ ADMINISTRATION

☐ COMMAND

PRINT your name below as you would like it to appear on the Certificate of Completion.

PLEASE SIGN AND DATE THIS FORM

SIGNATURE:

DATE:



Disaster Preparedness and Response Program
USAID/OFDA ■ Miami-Dade Fire Rescue

Collapsed Structure Search and Rescue (CSSR) Course
Health and Dietary Requirements Form

*This form will provide the coordinator with important information regarding your health or diet.
Turn this form in at the beginning of the course. **Please print clearly or type.***

COURSE LOCATION

COURSE DATES

START:

END:

PARTICIPANT'S FULL NAME

ARE YOU VEGETARIAN OR DO YOU HAVE ANY OTHER DIETARY RESTRICTIONS?

☐ YES ☐ NO

IF YES, PLEASE SPECIFY: _____

DO YOU HAVE ANY FOOD ALLERGIES?

☐ YES ☐ NO

IF YES, PLEASE EXPLAIN: _____

ARE YOU UNDER ANY MEDICAL TREATMENT, USING MEDICATIONS OR HAVE ANY PHYSICAL DISABILITIES?

☐ YES ☐ NO

IF YES, PLEASE EXPLAIN: _____

PLEASE SIGN AND DATE THIS FORM

SIGNATURE:

DATE:



**Disaster Preparedness and Response Program
USAID/OFDA ■ Miami-Dade Fire Rescue**

**Collapsed Structure Search and Rescue (CSSR) Course
Liability Release Form**

*All non-staff individuals involved in any part of the CSSR Course must complete and sign this form and submit it to the Course Coordinator by the beginning of the first day of class. **Please print clearly or type.***

COURSE LOCATION

COURSE DATES

START:

END:

PARTICIPANT'S FULL NAME (PRINTED)

PARTICIPANT'S PASSPORT NUMBER OR OTHER GOVERNMENT-ISSUED IDENTIFICATION NUMBER

NUMBER:

ISSUING COUNTRY:

LIABILITY RELEASE

I hereby acknowledge that I am fully aware of the risks to which I may be exposed during the CSSR Course, with potential minor and major accidents that may cause me or other persons bodily harm and/or illness. I fully understand and accept that the U.S. Office of Foreign Disaster Assistance (USAID/OFDA), the Miami-Dade Fire Rescue Department (MDRFD), as well as the course coordinator, instructors and assistant personnel, have taken every precaution possible to prevent accidents, injuries and illness during the course.

I agree to comply strictly with each and every safety standard of the CSSR Course. These safety standards have been made available to me in the Course Pre-Work and will be explained to me during the first lesson and throughout the course. I furthermore pledge to ensure my own safety and the safety of all other course participants to the best of my ability.

On the basis of the aforesaid, in the event of any accident that may cause me bodily injury or illness during or after the CSSR Course, I hereby release the U.S. Office of Foreign Disaster Assistance (USAID/OFDA), the Miami-Dade Fire Rescue Department (MDRFD), the course coordinator, instructors and assistant personnel from all legal liability thereof.

PLEASE SIGN AND DATE THIS FORM

SIGNATURE:

DATE:

2

Organising and Starting a CSSR Operation

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will be able to:

1. Define a collapsed structure search and rescue operation.
2. Describe the structure of a CSSR squad and the positions within it.
3. List the five phases of a CSSR operation.
4. List the six stages of the Operations Phase.
5. List the five steps of the initial assessment.
6. Describe how a CSSR squad fits into the Incident Command System.
7. Name the four levels in the scope of operations as they pertain to CSSR.

Approximate Duration:

- Lecture: 2 hours
- Practical component: None





1. Definition

Collapsed Structure Search and Rescue

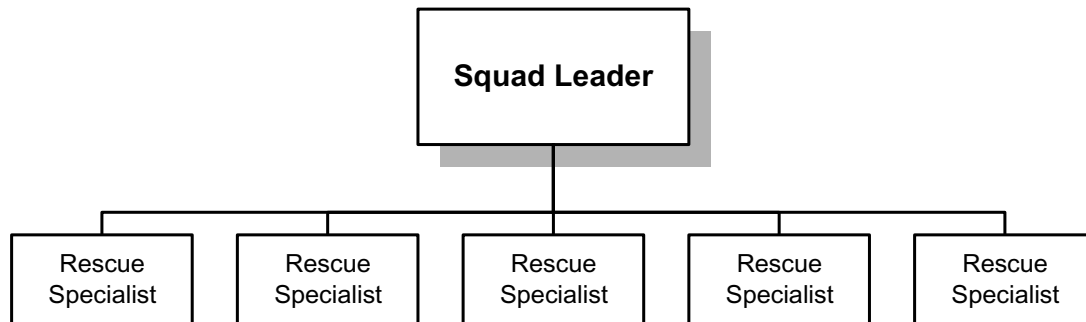
An operation to conduct safe and effective search and rescue operations at collapsed structure incidents involving the collapse or failure of reinforced and unreinforced masonry, concrete, tilt-up and heavy timber construction (NFPA 1470).



2. The CSSR Squad

An active component of an emergency response system whose purpose is to search for, locate, gain access to, stabilise and extricate trapped victims from a collapsed structure.

In accordance with NFPA guidelines (for safety reasons in a hazardous environment), the CSSR squad should have a maximum of six members, organised as shown in the following figure:



Following is a brief overview of the functions assigned to the members of a CSSR squad.



Squad Leader

1. Communicate with the Command Post (CP) or Emergency Operations Centre (EOC).
.....
2. Receive work instructions.
.....
3. Assign tasks to the rescuers.
.....
4. Decide which tools should be used to perform specific tasks.
.....
5. Monitor work rotations.
.....
6. Update the CP on progress and completed tasks.
.....
7. Safety officer for the squad.
.....
8. Maintain a log of all events, actions, and expenditures.
.....

Rescuers

1. Carry out work instructions from the Squad Leader.
.....
2. Use the tools, equipment and accessories correctly and safely.
.....
3. Update the Squad Leader on task progress.
.....
4. Request from the Squad Leader the resources necessary to complete the task.
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The **logistics position** is a rotating position within the squad. This rescuer is responsible for the tools, equipment and accessories, and other resources; squad members will take turns assuming this responsibility.

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It is standard procedure to work in pairs. The second rescuer stands behind the first, providing physical support and monitoring safety. Working in pairs also provides the opportunity for rotations and rest.

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Span of Control

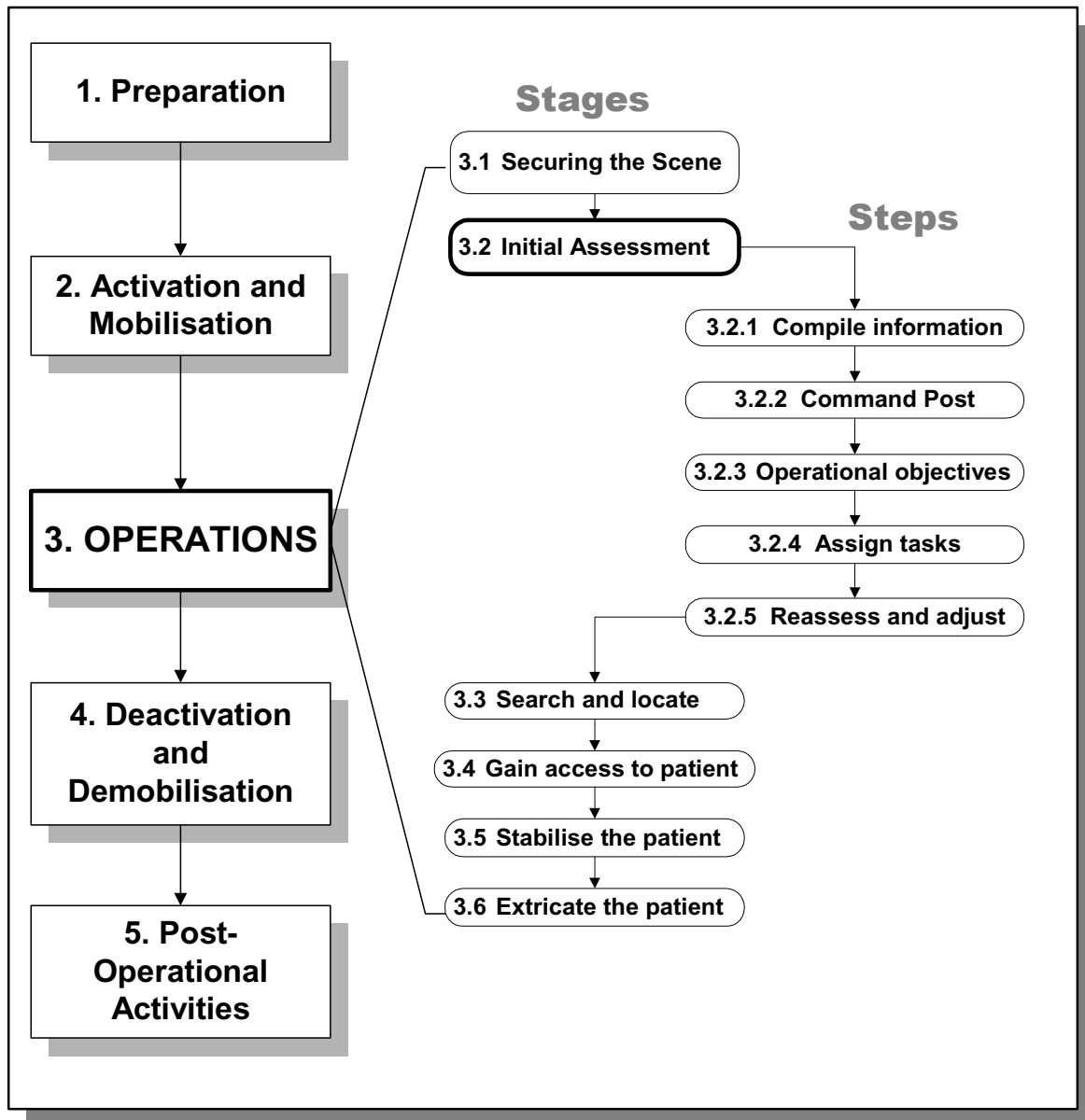
The limited number of people one person can effectively manage.

A supervisory ratio of three to seven individuals is recommended, with five being the optimum.

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3. Phases of a CSSR Operation





Phase I: Preparation (ongoing, before disaster)

- **Selection** of team members
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- **Training** of team members
.....
- Personal protective equipment (PPE)
.....
- Tools and equipment. Very important to maintain in proper **working** condition and ready for mobilisation to work site.
.....
- Make general transportation arrangements.
.....

Phase II: Activation (request to respond)

- Request transportation.
.....
- **Pack and load equipment.**
.....
- Notify team members.
.....
- Obtain information on **disaster**. This includes information such as type, location and topography, magnitude/area, number of people affected, number of buildings affected, weather, access routes
.....
- Brief team members on current situation.
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Phase III: Operations

The Operations Phase relates directly to search and rescue work, and is divided into six stages. The second stage, or Initial Assessment, consists of five steps.

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Stage 1: Securing the Scene

A procedure is carried out to ensure safety and protection to the fullest extent possible for the rescuers, bystanders and victims (hazard mitigation).

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Stage 2: Initial Assessment

This stage consists of a systematic and ordered procedure for analysing conditions during a CSSR operation. The purpose is to ensure safety and protection to the fullest extent possible for the rescuers, bystanders and victims (hazard mitigation). It begins with the operations phase and continues until the rescue operation is complete.

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The initial assessment consists of the following five steps:

Step 1. Once at the scene, consult local authorities, gather data and conduct a needs analysis. Confirm and update all information obtained in the activation phase.

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Step 2. Establish Command Post.

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Step 3. Establish operational objectives, such as:

- general access to the disaster site
- strategic planning and priorities
- allocating resources and personnel
- managing operations begun by neighbours or other organisations

Step 4. Assign tasks to rescue squads.

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Step 5. Reassess the situation and make necessary adjustments.

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Stage 3: Search and Locate

Conduct a search using a specific set of techniques to obtain a response or indications of the presence of live victims in a void space inside a collapsed structure.

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Stage 4: Gain Access to the victim

Remove rubble, break and breach materials and create a passageway to access the void space where a live victim is believed to be located.

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Stage 5: Stabilise the Victim

Perform basic life support on-site before extricating the victim in order to improve later chances of survival. You will hand off the victim to more advanced medical care after extrication.

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Stage 6: Extricate the Victim

Remove rubble surrounding the victim, ensuring no further injury. Shore loads as needed. Ensure no additional pressure is applied to any trapped portions of the body.

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Phase IV: Deactivation and Demobilisation

- Confirm no other operations are needed.
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- Account for all tools and equipment. Prepare tools and equipment and pack them for transportation.
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- Confirm that personnel have all their personal items.
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- Arrange for transportation.

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Phase V: Post-Operational Activities

- Critical Incident Stress Management (CISM)
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- Medical physical examinations for rescue personnel.
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- Equipment rehabilitation.
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- **Operational debriefing** with rescue team.
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- After-Action Report for institutional management.
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4. Incident Command System

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|---|
| Definition: A flexible system for managing people and resources. |
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The **Incident Command System** (ICS) provides a clear management framework for all types of small and large-scale incidents, such as multiple-casualty, multi-jurisdictional and multi-agency disasters, and wide-area search and rescue operations.

The organisation of the ICS is built around five major management activities: **command, operations, logistics, planning, and finance**.

These five elements are the foundation upon which the ICS organisation develops. They apply whether handling a routine emergency, organising a major event, or managing a major response to a disaster. The most commonly used elements are **command** and **operations**.

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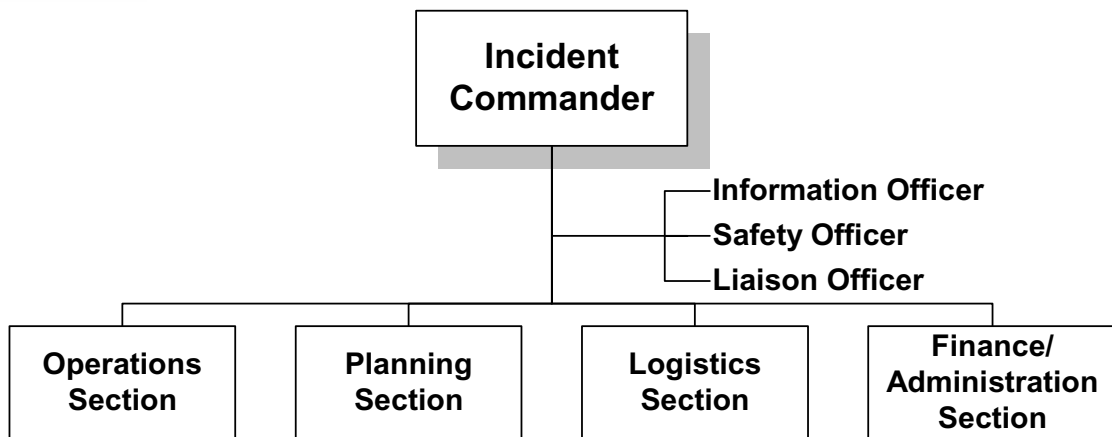


Figure 1. Simplified ICS organisational chart.

It is beyond the scope of this course to teach the Incident Command System; however, it is important to give you basic information about your potential role in any such incident.

4.1 Incident Commander

The Incident Commander (IC) is the person in charge at the incident who must be fully qualified to manage the incident. As incidents grow in size or become increasingly complex, a more highly qualified IC may be assigned by the responsible jurisdiction or agency.

The sole function of the IC is to manage the incident by assigning tactical resources and overseeing operations, delegating authority to others as required. The IC should not become involved in **hands-on activities**.

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4.2 Incident Command Post

The Incident Command Post (ICP) is the location from which the IC oversees all incident operations. There is only one ICP for each incident or event. Every incident or event must have some form of an Incident Command Post. The various section chiefs and Incident Commander's support staff will work out of the ICP.

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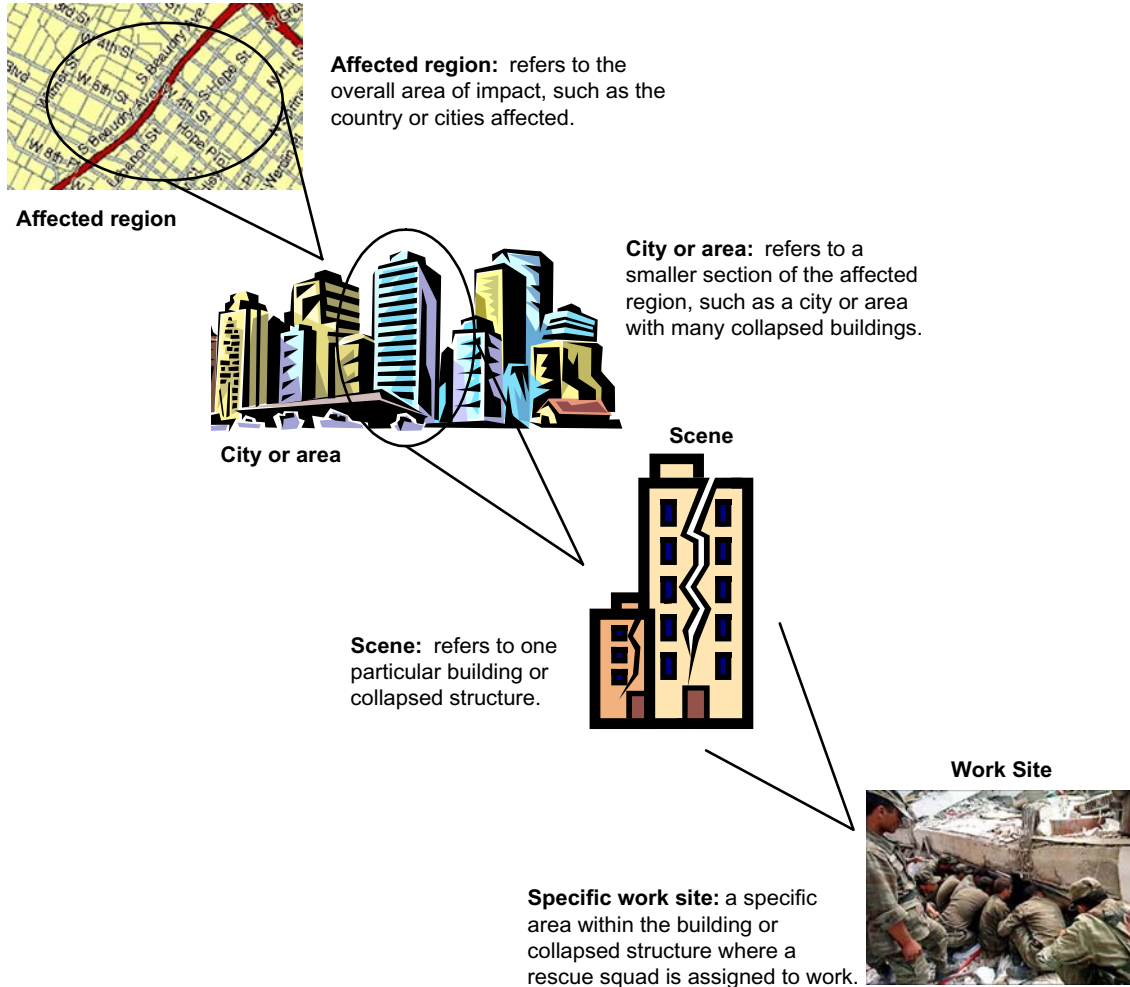
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5. Scope of Operation

In a large-scale emergency such as an earthquake, the area of impact will usually be over a wide area, possibly covering many cities. As a result, the incident will be managed by different groups at various levels, depending on their type of responsibility.



The work site is the scope of operation for a CSSR squad. As a member of a CSSR squad, you will be concerned only with performing rescue work on a specific site. Coordination on a larger scale will be taken care of by personnel at a different level of administration.

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3

Construction Materials, Structures and Damage Types

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will be able to:

1. Define construction materials and classify them by their composition types and uses.
2. List three properties of each material: concrete, steel and wood.
3. Describe two methods of construction.
4. List four types of structures.
5. List at least three characteristics of a building in each of the following four categories:
 - General
 - Architecture
 - Structural elements
 - Non-structural elements
6. List and describe three forces that can affect construction materials.
7. List and describe two types of damage in a structure and their potential resulting failures.
8. Name and describe the four basic collapse patterns.

Approximate Duration:

- Lecture: 1 hour, 30 minutes
- Practical component: None

1. Construction Materials

Natural materials processed by man and used in the construction of buildings, which consist of structural and non-structural elements.

1.1 Classification by Composition

a. **Stone:** Marble, granite.

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b. **Organic materials:** Wood, plywood, paper, particleboard

.....

c. **Metal:** iron, steel, aluminium.

.....

d. **Conglomerates:** concrete, plaster, adobe, clay

.....

e. **Ceramics:** tiles

.....

f. **Glass:** windows, glass block

.....

g. **Plastics:** polyurethane, polyethylene, thermosetting adhesive

.....

1.2 Classification by Use in the Structure

a. **Structural/load-bearing** elements

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b. **Decorative** elements and façades or veneers

.....

c. **Non-structural** walls and partitions

.....

d. **Covering** elements (roofing)

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2. Properties of Construction Materials

2.1 Concrete

A construction material consisting of a mix of cement, rock, sand and/or other inert materials, water and a small amount of air.

Characteristics

- Resistant to fire and compression
- Weak under tension and shear
- Continues to harden with time
- Very heavy: one cubic meter (m³) weighs almost 3,000 kg



Concrete cures by hydration, meaning that it needs water to harden. Once dry, concrete always develops cracks, which do not necessarily represent a failure. Concrete is strong in compression but weak in tension, which is why steel rebar is a necessary component of concrete beams, columns and floors.

To appreciate the significance of concrete in construction and rescue operations, you must know how much it weighs: approximately 2,400-3,000 kg/m³. On a smaller scale, a piece of concrete measuring 15 cm x 30 cm x 30 cm weighs approximately 34 kg.

2.2 Steel

Characteristics

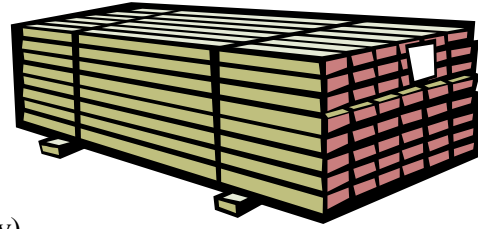
- Can be bent without breaking (malleable)
- Resistant to fire and compression
- Easily conducts heat, sound and electricity



2.3 Wood

Characteristics

- Easy to cut
- Light
- Not fire-resistant
- Good insulator (will not transmit electricity)
- Provides warning — creaks before breaking



3. Methods of Construction

The type of construction will give some indication of the way a building will collapse. Experience has shown that there are patterns in the way structures collapse. Therefore, this knowledge is useful in determining the **probable location** of voids and spaces where victims may be trapped, and in selecting the methods to employ in extricating them. Buildings can be divided into two main categories: framed and unframed.

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3.1 Unframed Structures

Unframed structures are those in which the weight of the floors and roof are supported by the bearing walls. Examples of this type of structures are brick and joist buildings and wood apartment buildings. As a general rule, these do not exceed seven stories in height. Rescue operations in unframed structure collapses are usually difficult, lengthy and dangerous. To the uninitiated, an extensive collapse gives the impression that the occupants have little chance of survival. Fortunately, rescues can be made because of the formation of voids created by structural members, strong objects such as machinery and heavy furniture, or a combination of these.

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3.2 Framed Structures

Framed structures are erected by constructing a structural steel or reinforced concrete skeleton made of horizontal beams and vertical columns. The floors and/or roof are **not** dependent on the walls for support. Collapse can be more localized, but older concrete structures can suffer a pancake failure, and some steel structures with poor joints have overturned. The rescue teams face the same problem and seek out voids created by the collapse, as in unframed structures. Many buildings have elements of both unframed and framed structures. Most buildings have non-bearing walls. A common structure is one with exterior bearing walls with an interior framed system. A few examples would be tilt-up concrete walls with a wood roof and floors, and older brick or concrete wall warehouses with wood or concrete floors.

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4. Structural Types

Based on experience with earthquakes and collapses, building types can be also divided into four separate groups, with each exhibiting a distinctive collapse pattern. These groups are:

4.1 Light Frame

Residential homes and apartments of up to four stories, and constructed mainly of wood. The principal weakness is the lateral strength of the walls and the connections.

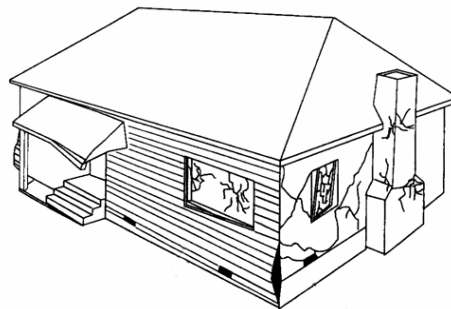
Rescuers operating in a light-frame building collapse should check for stability problems by looking for badly cracked or leaning walls, and offset of the structure from the foundation, or a leaning first story in multi-floor dwellings.

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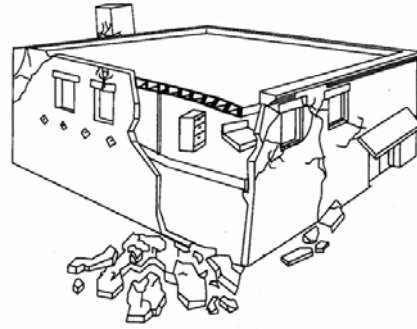
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4.2 Heavy Wall (URM) Unreinforced Masonry

These buildings are one to six stories in height, and may be residential, commercial, industrial, or institutional. They have heavy masonry walls and wooden floors. When operating in an unreinforced masonry building make sure to check for loose and broken parapet walls and ornamental masonry, broken connections between walls and floors, cracked wall corners, and unsupported and partially collapsed floors.



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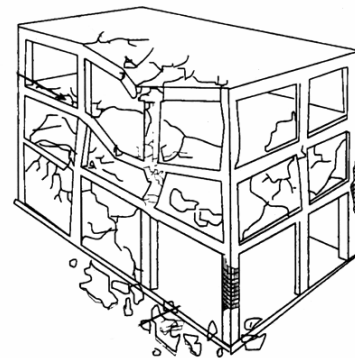
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4.3 Heavy Floor

Structures in this category can be residential, commercial, or industrial (concrete highway bridges). They have concrete frames and may be up to twelve stories tall.

Rescuers should evaluate the stability of the structure by checking:

- the confinement of the concrete within the reinforcement of the columns.
- Cracking of columns at each floor line.
- Diagonal shear cracking in major beams adjacent to supporting columns.
- Cracks in shear walls.



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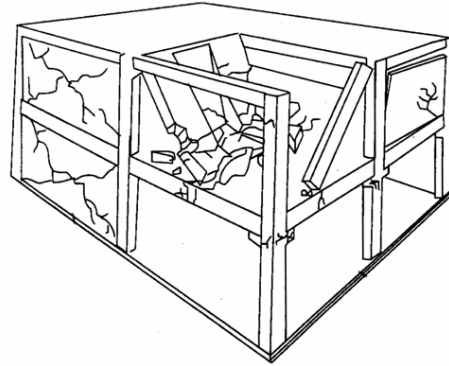
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4.4 Pre-Cast Concrete

Buildings with fairly heavy floors and some heavy walls. Pre-cast structures may be commercial or residential and also include pre-cast parking facilities. These structures generally are one to twelve stories in height. Principal weakness is in interconnection of parts: slabs to walls/beams; beams to columns; walls to slabs, etc. Rescuers operating at a pre-cast building collapse should check for badly cracked walls, beam-to-column connections for broken welds and cracked corbels, column cracking at the top and the bottom of joints, and wall panel connections and shear wall connections at floor areas.



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5. Characteristics of a Structure

After seismic activity or other force causes structural and non-structural damage, it is important to relate the characteristics of the structure to the damage it has suffered.

5.1 General

General characteristics of a structure include the following elements:

- Occupancy type

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- Modifications to the original structure/plans (if applicable)

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- Location of utilities

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- Contents

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- Number of occupants

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5.2 Architecture

Architectural characteristics of a structure include the following elements:

- Shape of building and foundation

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- Height and number of *floors*

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- Number of *basement levels*

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- Major cantilevers

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- Location of *chases* (stairwells, elevator shafts and service chutes)

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- Primary materials used

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5.3 Structural Elements

The structural or load-bearing elements of a structure include the following:

- Columns

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- Beams, girders, trusses, joists, rafters, purlins, studs

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- Floor slabs, roof

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- Load-bearing walls

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- Foundations

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5.4 Non-structural Elements

- Non-load-bearing walls, partitions, in-fill

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- Windows, doors and other openings (fenestrations)

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- Façades, veneers, parapets, and other

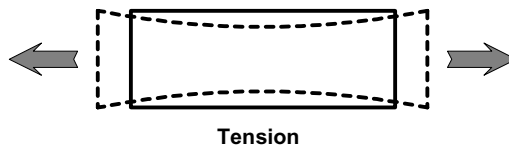
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6. Forces Acting on Construction Materials

6.1 Tension

Forces that act to elongate or stretch a material.

Examples:

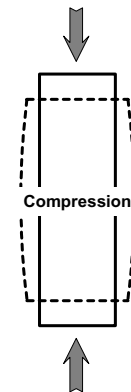


6.2 Compression

Forces that act to crush or compress a material.

Examples:

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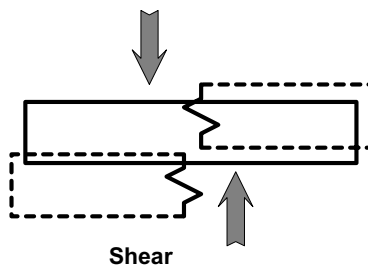


6.3 Shear

Forces acting in opposite, parallel directions and on different planes, such that they cut or break a material.

Examples:

.....



The forces of tension, compression and shear, and combinations of these, are those that affect materials and structures, with the potential to cause damage.

7. Damage Types and Potential Hazards

Damage to buildings can be categorized as structural and non-structural. **Structural damage** affects the **structural** elements of a building, and likewise, non-structural damage affects the **non-structural** elements of a building. However, both types of damage are capable of causing injury, death, contamination and other hazards.

7.1 Structural Damage

- Total structural collapse
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- Leaning floors, roofs and walls
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- ***Collapsed floors and roofs***
.....
- Collapsed columns in one or more floors
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- Substantial, permanent ***lateral*** shift in the structure
.....
- ***Cracks in columns, floor slabs and/or bearing walls***
.....
- Cracked foundation
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- Cracked elevator shaft
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7.2 Non-Structural Damage

- Generalized cracking
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- ***Cracked or fallen exterior façades and veneers***
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- Fallen staircases
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- Shift in the elevator shaft

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- **Damaged utilities**

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- Building signs and balconies

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7.3 Types of Hazards

In damaged, partially and fully collapsed structures, we can identify three types of hazards:

- **Falling:** Part of the structure or its contents are in danger of falling.

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- **Collapse:** The volume of enclosed space made by the structure will be reduced as stability is lost.

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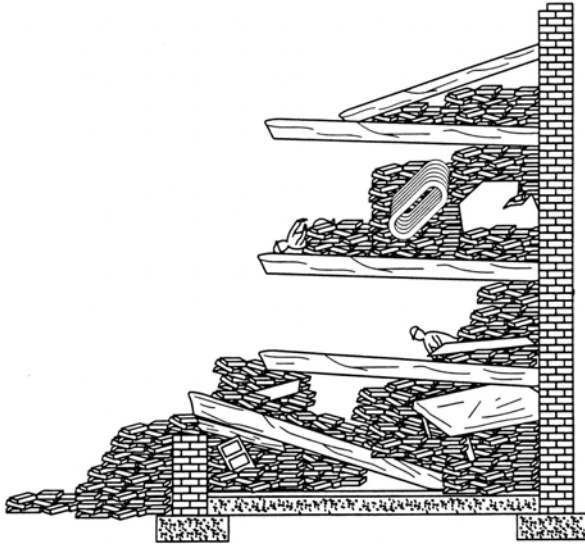
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- **Other types:** Electricity, water, fuels, toxic gases (carbon monoxide), hazardous materials (asbestos), biohazards (blood), etc.

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8. Basic Collapse Patterns

8.1 Cantilever

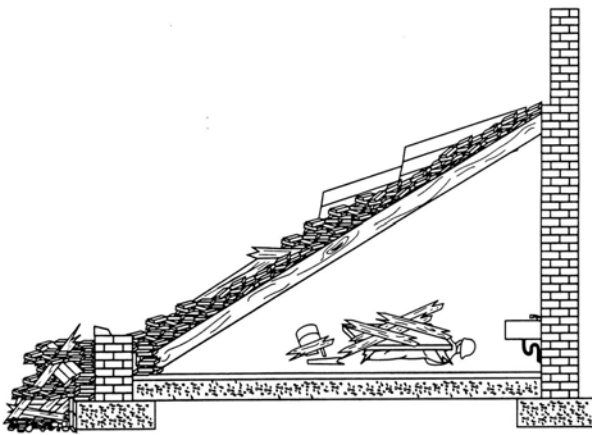


Cantilever

Results from a wall collapse which allows a floor or roof assembly to drop partially, but to remain suspended above the floor or base below on the side where the wall failed. The opposite end of the floor assembly remains attached to the wall and at its original connection point.

This type of collapse is extremely unstable and dangerous.

8.2 Lean-to

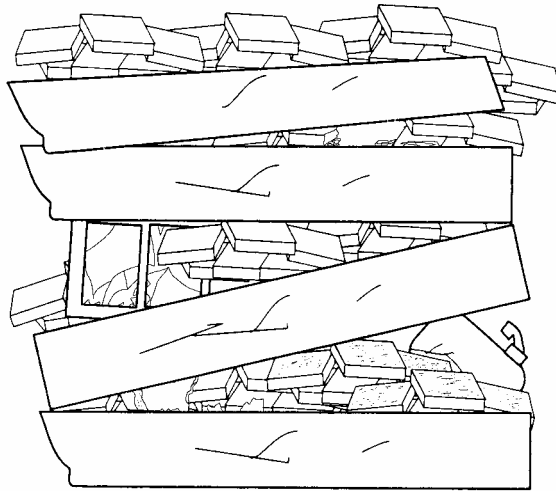


Lean-to

Found where a wall failure causes a floor or roof section to fall completely on one side, while the other end remains supported.

This collapsed usually results in a triangular void.

Remember that the remaining supported end of the fallen section may be precariously supported.

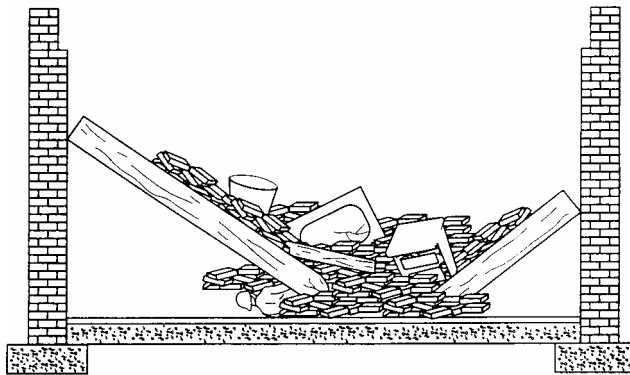


Pancake

8.3 Pancake

Refer to multi-floor collapses where several floor slabs completely fail and **stack up** on top of each other.

The resulting voids are **limited** in space and are difficult to access, especially in concrete structures.



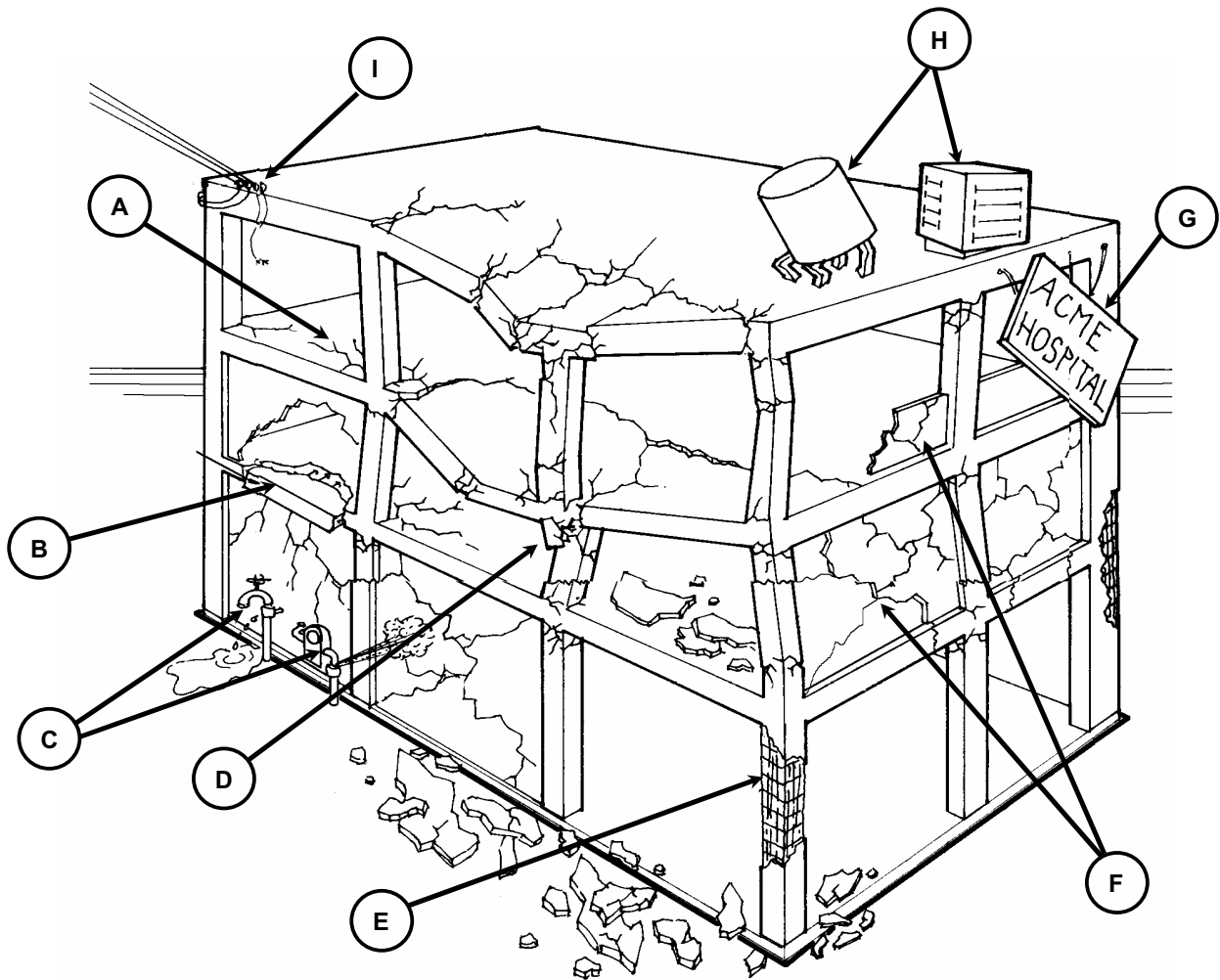
V-Shape

8.4 V-Shape

This collapse will be created when a floor assembly collapses in the **middle** due to failure of centre supports or overload of the floor.

The result is two identifiable voids which are created on **each side** of the broken floor assembly.

Identify the Failure Types



Identify the failure types above and whether they are structural or non-structural:

- A.
- B.
- C.
- D.
- E.
- F.
- G.
- H.
- I.

4

Structural Triage and the INSARAG Marking System

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Objectives

Upon completing this lesson, you will be able to:

1. Define structural triage.
2. List at least five basic rules for structural triage.
3. List at least five factors to consider in structural triage.
4. Define the INSARAG marking system.
5. List and describe the five categories of the INSARAG marking system.
6. Demonstrate in a written exercise the use of the INSARAG building marking system.

Approximate Duration:

- Lecture: 1 hour 30 minutes
- Practical component: None



1. Structural Triage

A rapid assessment of buildings during a CSSR operation, for the purpose of selecting those structures in which there is a **greater likelihood** of finding, accessing, and rescuing live victims.

Structural triage is conducted in two stages:

1. The overall area that has been most affected is assessed
2. Individual buildings are selected

2. Basic Rules for Structural Triage

The goal is to maximise the number of live victims rescued while minimizing risk to the victims and rescue squad. Structural triage must be conducted according to the following rules:

- a. It is performed when **three** or more structures are assigned to a single CSSR squad.
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- b. Performed by a team of structure specialists and hazardous materials specialists.
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- c. For each group of buildings assigned to a CSSR squad, triage should be completed within **two** hours. Structural triage should take no more than 15 minutes per building or structure.
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- d. Search and rescue operations can only begin **after** triage is completed and priorities are established.
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- e. Once the initial buildings have been prioritised, a detailed assessment can be performed and structures marked during the initial search.
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- f. If there are many buildings to inspect, two groups may be assigned to perform triage.
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- g. Buildings that are found to be too hazardous in which to conduct rescue operations must be clearly marked with “**NO GO**” except when there is a live victim in the building. In that situation, you need to consider the risk/benefit factor.

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- h. Structural triage should be re-evaluated after live victims are found.

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- i. Structural triage must be **repeated** after any significant event such as an after-shock or heavy equipment usage.

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3. Factors in Structural Triage

When performing structural triage, it is necessary to gather as much information as possible. The following factors must be considered:

- Occupancy type

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- Type of structure

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- Condition of the structure

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- Mechanism of collapse

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- Day, date and time of collapse

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- Prior intelligence

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- Availability of resources

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- Location of utility shut-offs

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- Possible presence of hazardous materials

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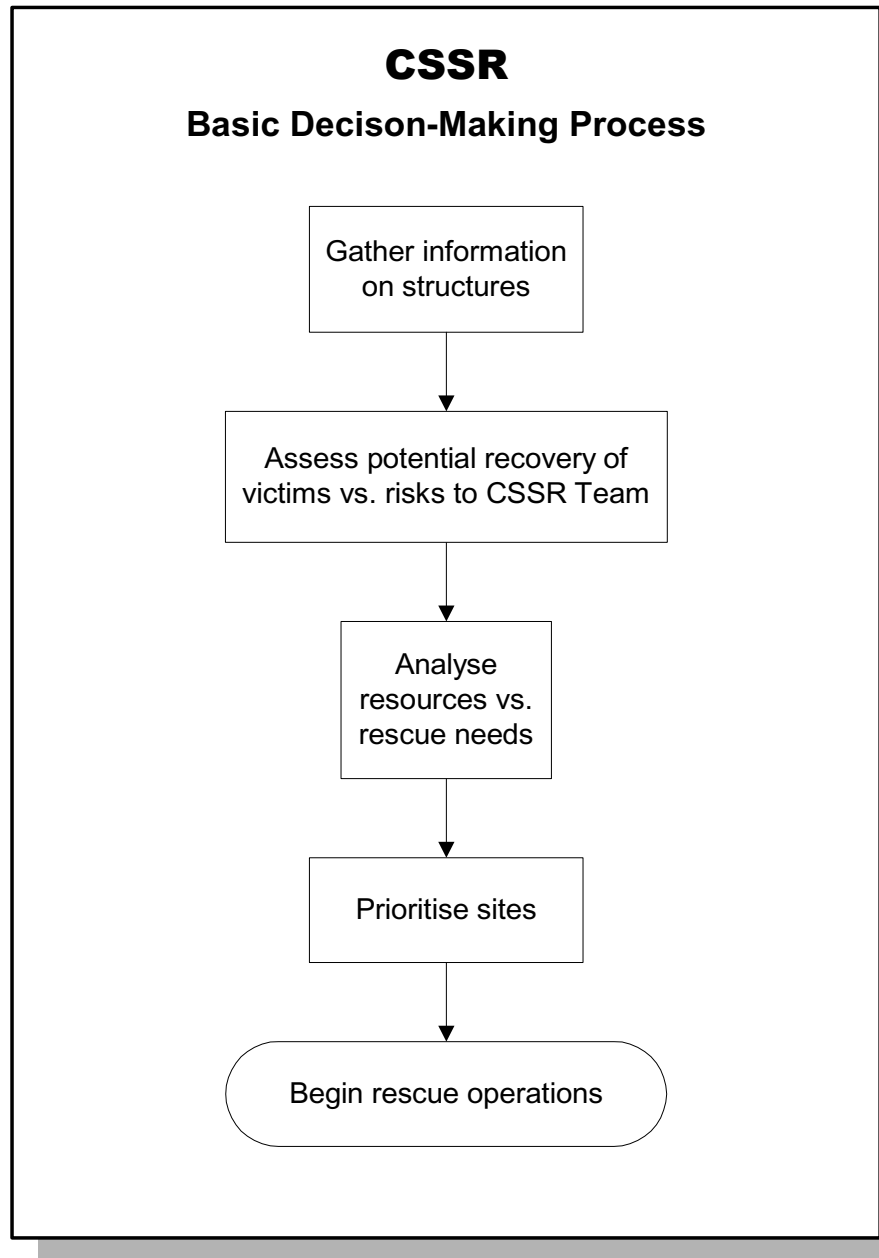


Figure 1. Simplified structural triage decision-making flowchart.

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4. INSARAG Marking System

A **system** used to **identify** structures, conditions, hazards and victim status in a standardised, simple and clear fashion that can be understood by **all** local, national and international rescue personnel.

The CSSR marking system was developed by the International Search and Rescue Advisory Group (INSARAG). It provides for conspicuous identification of work site hazards, standardised mapping, sketch and landmark labelling with common symbols, ensures the accuracy of search assessment markings and documents CSSR team accomplishments.

The building marking system incorporates the following elements:

- **Common identification system:** marking and signalling.
- **Structure assessment:** go/no-go, search, rescue, and special hazards of a particular structure, victim location.
- **Results:** warning, tracking, and continuity/ease of work transfer (interoperability).



All markings must be conspicuous, using a high-contrast, durable, fluorescent colour.

5. Marking System Information Categories

The CSSR marking system can be divided into the following five categories:

- Assigned areas or work sites
- Structure assessment marking
- General hazard marking
- Facility and vehicle markings
- Team and function markings

5.1 Assigned Areas or Work Sites

Certain markings are used to identify sites individually (e.g., by address, physical location, unique design, etc.). If no maps are available, proceed with one of the following:

- Sketch a map by hand.
- Identify and label landmarks.
- Assign a name to each site (using GPS references).

Establish structure orientation on the map or sketch, including exterior and interior.

Location References of a Structure

It is important to identify locations within and around a single structure. On the exterior of the structure, the **address side** of the structure is defined as Side 1. Other sides of the structure shall be assigned numerically in a clockwise manner from SIDE 1, as shown in Figure 2.

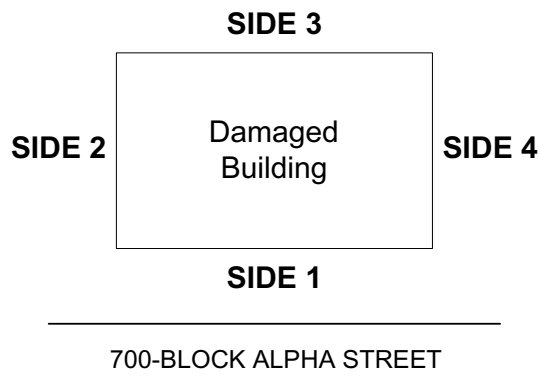


Figure 2. Exterior location references of a structure.

The interior of the structure will be divided into **quadrants**. The quadrants are identified **alphabetically** in a clockwise manner starting from where SIDE 1 and SIDE 2 meet. The centre core, where all four quadrants meet, is identified as **QUADRANT E** (i.e., central lobby, etc.), as shown in Figure 3.

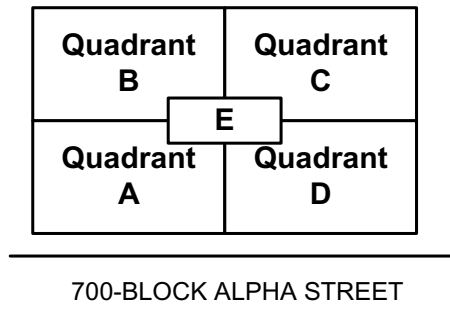


Figure 3. Interior location references within a structure.

Identifying Floors

Multi-story structures must have each floor clearly identified. If this is not so, the floors should be numbered as referenced from the exterior. The **grade-level** floor is designated as the **ground** floor. The floors above are numbered as **Floor 1**, **Floor 2**, etc. Conversely, the floors below the ground floor are **Basement 1**, **Basement 2**, etc. Refer to Figure 4.

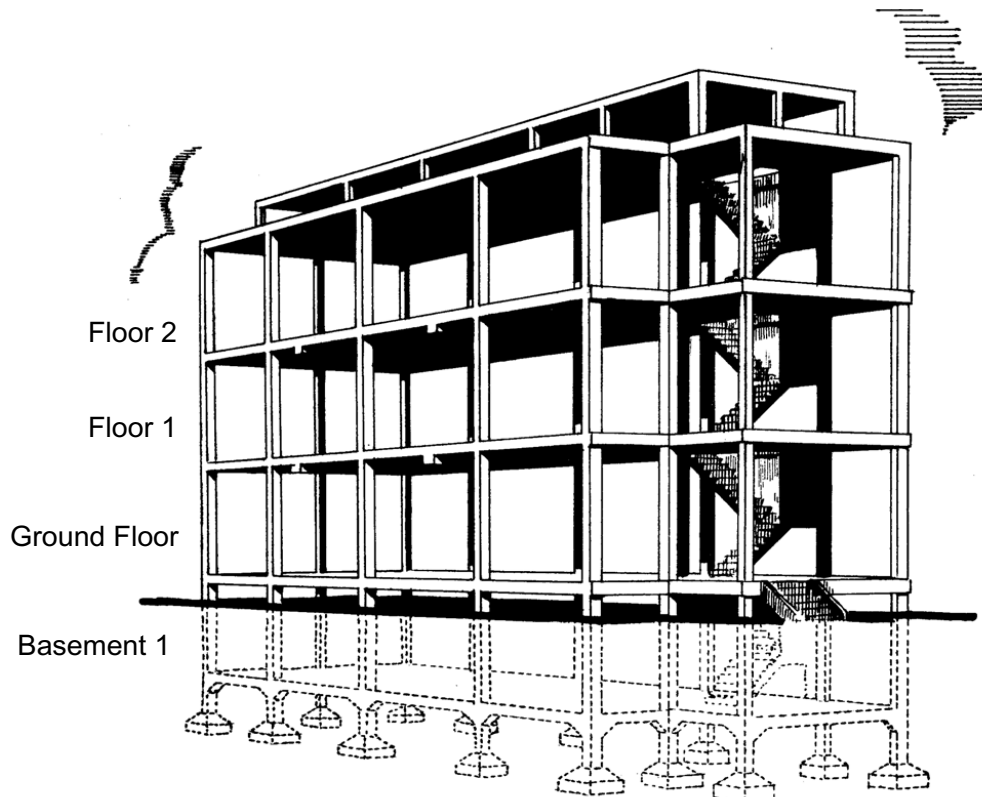


Figure 4. Identifying floors in a structure.

Identifying Columns

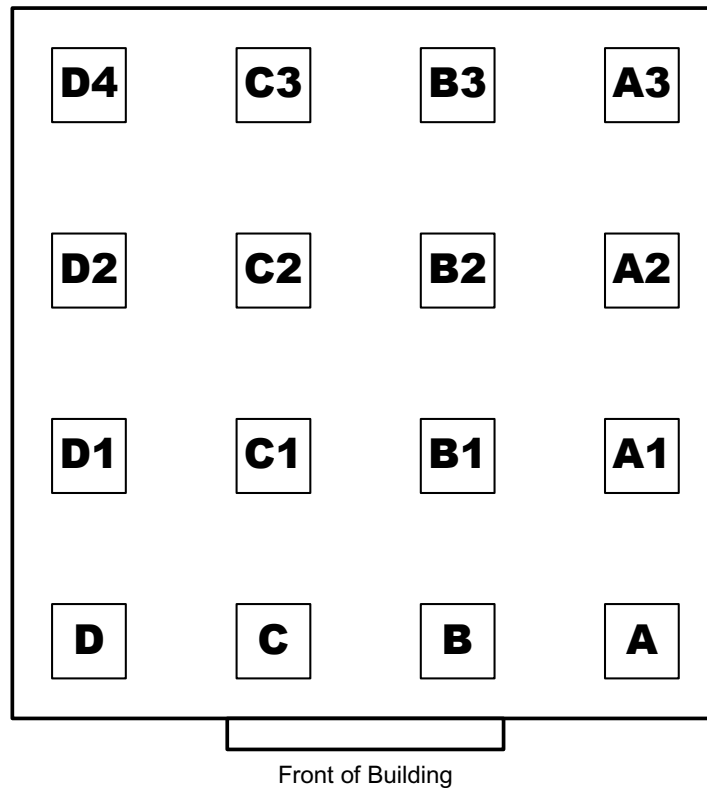


Figure 5. Identifying columns in a structure.

5.2 Structure Assessment Marking

Markings are also used to notate structure and hazards assessment as well as the location of victims. Figure 4 below shows the standard format for structure assessment marking. It identifies the condition of the structure and associated hazards in addition to the location of victims. The symbol consists of a square figure, 1 metre by 1 metre, at the primary access point into any compromised structure.

Building marking must include the following information:

- Over the top of the box should appear information regarding the structure and possible hazards. This should also note hazards on the outside of building such as overhead hanging dangers.

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- On left side of box will appear number of live victims removed from the building.

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- On the right side of the box will appear the number of dead removed from building.

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- At the bottom of box information on number of persons that are missing and possible location of victims within the building is written here.

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- Information contained inside the box; whether or not it is safe to work in the building (Go or No-Go), the name of the search and rescue squad doing the work in the building, the time and date that work was started, and the time and date that the squad left the building.

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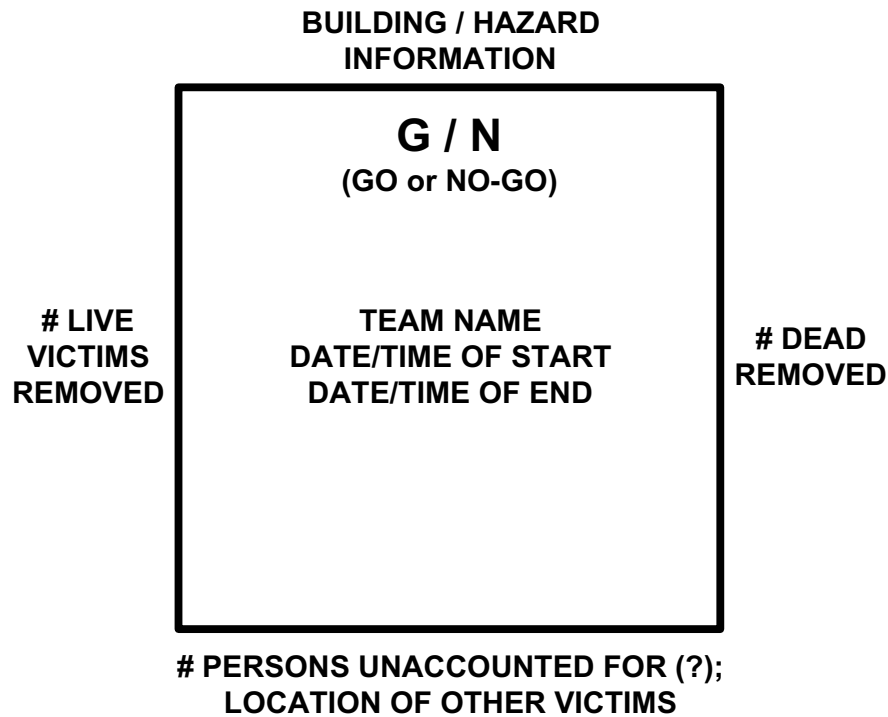


Figure 6. Format for structure assessment marking.

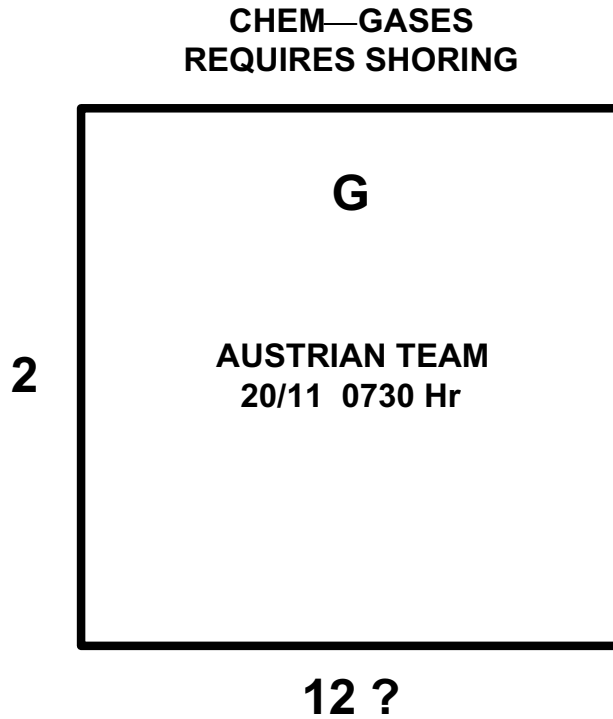


Figure 7. Sample marking box in progress, not complete.

It is important that the squad's name is clear so if there are any questions about the building, others will know where to go for this information.

As the situation changes in the building, whether it is the securing of a hazardous condition or as victims are removed or new ones found, it is important that the markings on the building reflect this new information. If a new box is needed to show this new information make sure that old markings are clearly ***crossed out*** so there is no confusion with the new markings.

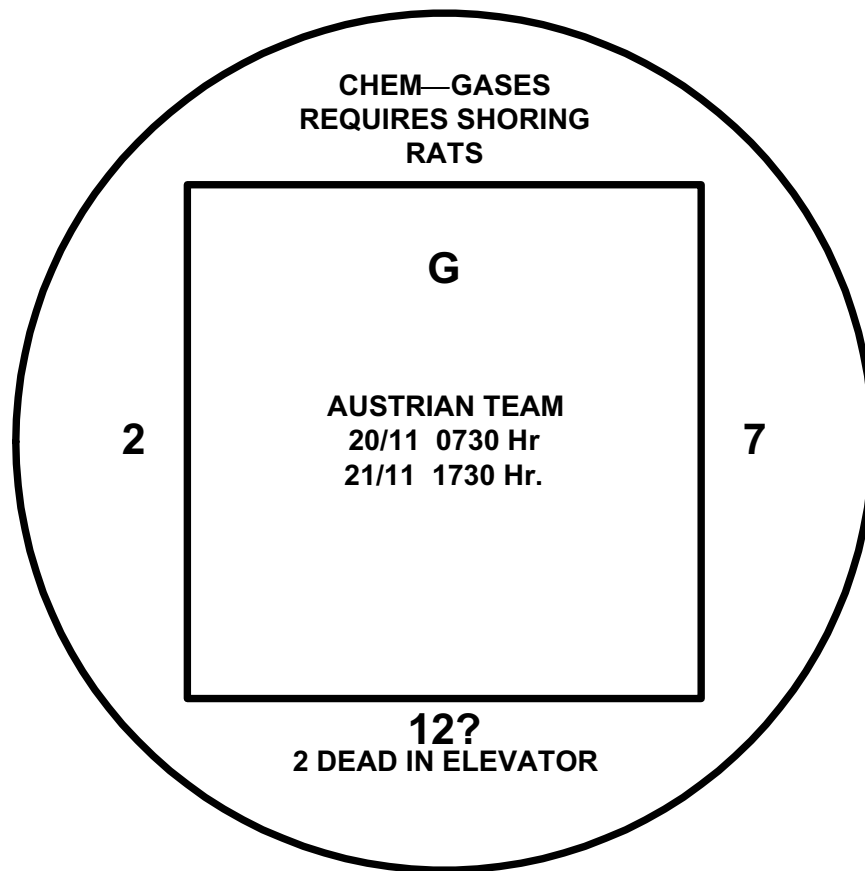


Figure 8. Sample marking box showing operation is complete.

Marking Victim Locations

During the search function, it is necessary to identify the location of any known or potential victim. The amount and type of debris in the area may completely cover or obstruct the location of the known or potential victim.

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The search squad or other individuals conducting search and rescue operations should make victim location markings every time a known or potential victim is located and not immediately removed.

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Method: Draw a large ‘V’ as close as possible to the location of known or potential victims.

- If there is only the potential presence of a victim(s) place only a ‘V’ at a point closest to the potential victim’s location (Figure 9).

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- If the presence of a live victim(s) is confirmed, place an arrow pointing toward the victim(s) location next to the 'V' (Figure 10). Confirmation of a victim requires either visual or audible contact.

- If the victim(s) are confirmed dead, draw a horizontal line through the 'V' along with an arrow indicating victim's location (Figure 12).

- Draw a separate 'V' to indicate either a live and/or dead victim(s).

Canine Alerts: All search dogs must be certified search canines (K-9). A single canine alert requires a 'V' marking only (no arrow) to indicate the location of a potential victim. If a second canine alerts at the same location, draw an arrow next to the 'V'.



Figure 9. Potential victim location.

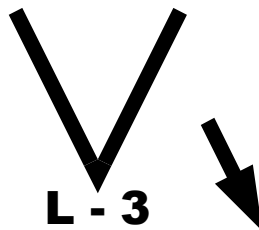


Figure 10. Confirmed live victim.

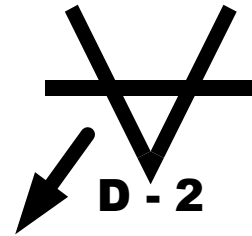


Figure 11. Confirmed dead victims.

The numbers **L-3** and **D-2** under the 'V's indicate the number of live and dead victim(s) at this location. This number will decrease or increase as known victims are removed, debris is moved and possibly new victims found.

Figure 12 shows that as victims are removed crossing out the number located below the 'V' is acceptable. It will then be replaced with the new number of victims.



Figure 12. Update of victim count.

Completion of Victim Extrication

To indicate that all victims, alive or dead, have been removed, draw a circle around the 'V' markings.

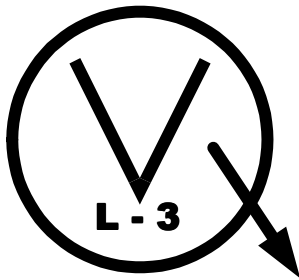


Figure 13. Extricated live victims.

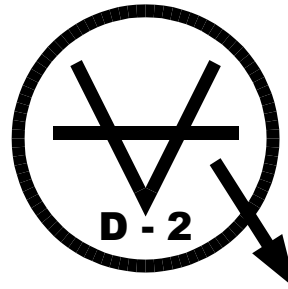


Figure 14. Extricated dead victims.

5.3 General Hazard Marking

General cordon markings (cordon banners, flagging, etc.) should be used for a small, defined area. The area can be expanded to include other non-buildings (such as bridges, danger zones, nuclear-biological-chemical [NBC], security, etc.). Large areas may require barricades/fences/patrol, etc. An operational work zone requires a single strand of tape across the perimeter; a collapse or hazard zone requires two strands crossed like an 'X'.

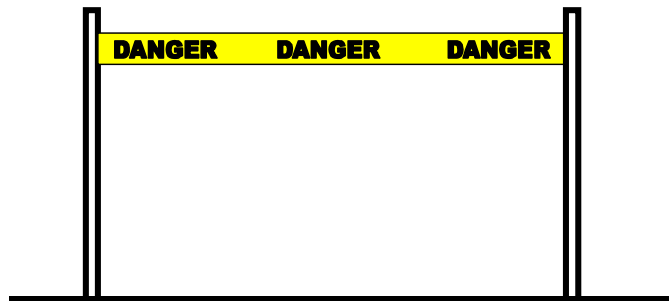


Figure 15. Operational work zone.

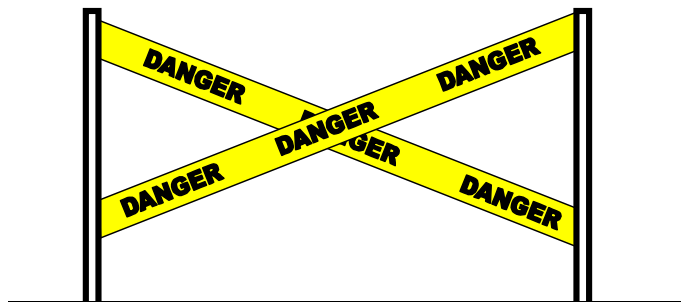


Figure 16. Collapse / hazard zone.

5.4 Facility and Vehicle Markings

Facilities: Iconic flags, banners, balloons, or other must be used to identify the team, team medical facility, the command post, etc.



Vehicles: Vehicles must be marked with team name and function by a flag, magnetic sign, etc.

5.5 Team and Function Markings

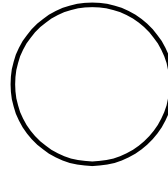
The following information must be clearly displayed on all emergency personnel:

- Response **team** identity (country and team name) by uniform, patch, etc.
- Personnel positions must be colour-coded and labelled in **English** plain text (using vests, arm bands, helmet colour, etc.)
 - Management position(s): white
 - Medical position(s): red cross/crescent
 - Safety/security position(s): orange



5.6 Other Symbols

Facilities — circles



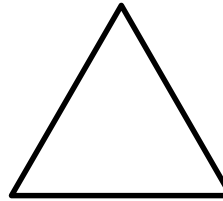
Zones — irregular shapes



Command Function — box



Reference point — triangle



Time notation

(with arrow pointing to activity site)

22/11 0700 Hrs.
23/11 1900 Hrs.

5

Operational Safety

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will be able to:

1. List at least five dangers a rescuer faces in a CSSR operation.
2. Identify unsafe actions and unsafe conditions.
3. Identify the CSSR Course safety rules.
4. List at least three safety concerns for each phase of a CSSR operation.
5. Describe the function and importance of having a Safety Officer in a CSSR squad.
6. Identify the four parts of a CSSR safety plan and briefly describe each one.
7. Describe the purpose of the Safety Briefing and list its eight components.

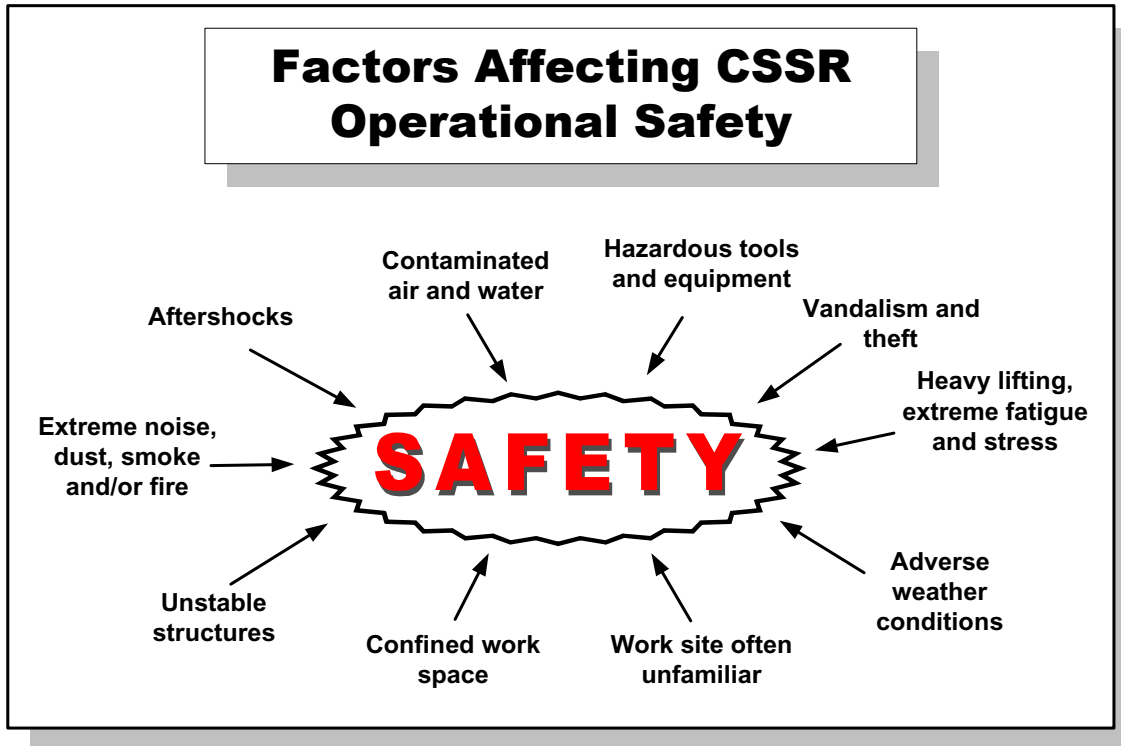
Approximate Duration:

- Lecture: 2 hours
- Practical component: None



1. Safety in a CSSR Operation

CSSR operations are the most complex and difficult activities that first responder teams face in the line of duty. There may be numerous factors affecting safety during a CSSR operation, as shown below.



Notes: _____

2. Operational Standards

- Follow established formats when working

- Safety Rules

3. Safe and Unsafe Actions and Conditions

- Safe actions and conditions

- Unsafe actions and conditions

4. CSSR Course Safety Rules

Due to the risks associated with the use of tools and equipment and the environmental conditions under which the CSSR Course is conducted, all persons involved in any manner with the course **must** follow the safety rules outlined below.

1. **Practice areas:** No one is allowed to enter the practice areas without explicit prior authorisation from the instructor in charge or the Course Coordinator.

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2. **Personal protective equipment:** Anyone entering the practice area must be wearing (in the correct manner) **all** required personal protective equipment described in Lesson 1 (Course Introduction).

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3. **Hygiene:** To reduce as much as possible the possibility of contamination or contagion, **you must wash your hands** with soap and water before and after entering the work area; before and after eating; and before and after using the bathroom.

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4. **Safety officer:** During the exercises and practicals, one individual from the Course personnel will be the designated safety officer and will be clearly and visibly identified. This person will be in charge of all safety-related matters throughout the entire course, and will have the authority to partially or completely halt all activities if needed.

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5. **Group safety:** Each instructor and team leader will also be responsible for the safety of the people in their respective groups. Should you observe any unsafe action or condition, or an emergency, immediately alert the Safety Officer. For this purpose, everyone will receive an emergency whistle to use in an emergency.

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6. **Whistle signals:** The Safety Officer will use the whistle to give alarm signals and alerts in the work area using the following signal system:

- **One long signal:** stop all work and listen for instructions.

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- **One long, one short:** continue working.

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- **Three short signals:** alarm signal, evacuate the area immediately to a previously designated safety zone.

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7. **Safety Zone:** The Safety Officer will establish a safety zone near the work area. The safety zone will be used in case of any emergency requiring immediate evacuation of the work area.

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8. **Emergency medical services:** A medical first responder kit and a means of communications must be made available to ensure EMS arrival within 15 minutes, should the need ever arise.

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9. **Fire extinguisher:** A portable 20-pound (9-kilo) dry-chemical fire extinguisher will be available in case of fire. You must be aware of its location during the course, especially when refuelling or lubricating equipment used in this course.

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10. **Drinking water:** During all practical exercises you must carry a canteen or drinking bottle filled with drinking water, to prevent dehydration. A water container for all participants will be available near the work area.

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11. **Maintenance:** You are responsible for maintaining all tools, equipment and accessories. Instructions and standards for maintenance are described in their respective manuals. Additionally, the instructor in charge of each particular exercise or practical session may provide instructions for maintenance.

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12. **Rotations:** Each work group must complete personnel rotations as directed by the Safety Officer. Under normal conditions rotations will be every 15 minutes, but weather may be a factor.

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13. **Trash:** All trash must be placed into designated trash cans or waste containers. No littering is permitted.

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14. **Smoking and drinking:** No smoking or drinking is allowed in the active work area.

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15. **Weather conditions:** The Safety Officer will decide whether exercises can continue in the work area during adverse or threatening weather.

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16. **Safety markings:** All objects or areas in the work area that may pose a hazard to anyone must be marked with scene tape or safety cones.

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17. **Team Safety:** All operations involving the use of tools and equipment must be conducted in pairs, so that one person can use the tool or equipment while the other acts as a safety lookout. The safety lookout will use a signal system in which one tap on the shoulder means to stop working, and two taps means to continue.

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18. **Safety violations:** Any participant who repeatedly violates or disregards the safety rules of this course, endangering him/herself or others, may be expelled from the course at the discretion of the Course Coordinator. No certificate or letter of attendance will be issued in this case.

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19. **Miscellaneous:** The Course Coordinator will resolve any other safety issue not specifically covered in the CSSR Course Safety Rules.

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Additional notes on safety

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5. Safety Considerations during Mission Phases

- The CSSR Team Leader is responsible for the safety of his team members.
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- Because there is no one person in a CSSR team designated as a Safety Officer, every team member must remain acutely aware of safety at all times and look out for each other.
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- All CSSR team members are responsible for giving warning about and preventing unsafe actions and/or conditions during all phases of a CSSR operation.
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SAFETY
Is
EVERYONE'S
responsibility

5.1 Preparation Phase

- Cultivate a positive attitude toward safety in your team members during class time and practical exercises.

Understand safety as a vital component of ensuring we stay alive.

- Safe procedures and protocols

Ensure the safety and well-being of our teammates as well as of those we seek to help (there is nothing worse than a rescuer needing rescue).

- Equipment

Maintain proper operation, cleaning and packing.

- Personnel

Well-trained, knowledgeable and experienced (prepared physically and mentally)

- e. Training

Trained and skilled in the equipment and techniques they will be using.

- f. Information

Well informed of administrative procedures, functions and problems that may arise.

5.2 Activation and Mobilisation Phase

- a. Establish safety procedures and practices from the start of mission.

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- b. Emphasise safety during briefings.

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- c. Make sure all CSSR team members have complete PPE and are in good mental and physical condition. Everyone must remove rings and all other jewellery to reduce risks.

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- d. Ensure safety when boarding or disembarking air transport

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5.3 Operations Phase

- a. Correctly identify the risks in the following:

- Base of operations

- Work area

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**The operations phase
of a CSSR operation
presents the greatest
level of risk.**

**REINFORCE
SAFETY**

b. Include the following in daily briefings:

- Alert and alarm signals
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- Escape routes and meeting places
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- Designate safety officer, if appropriate
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- Use of identification vests
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- Medical facility location and transportation method in case of accident or injury
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c. Safety guidelines while working on-site:

- Include safety standards in the work plan.
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- Monitor operations and logistical activities for compliance with safety standards.
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- Ensure that site hazards have been clearly identified.
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- Monitor radio communications.
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- Emphasise counting of personnel.
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- Emphasise personnel rotations.
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- Monitor personnel for fatigue and stress.
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- d. Team leaders must ensure all personnel follow hygiene rules, especially before and after eating.

Washing your hands will help prevent you from contaminating yourself and others.



- e. Report and investigate all injuries and accidents.

5.4 Deactivation and Demobilisation Phase

Similar to the Activation and Mobilisation Phase. Emphasise fatigue, stress and post-traumatic stress disorder (PTSD).

5.5 Post-Mission Activities

As soon as possible, document strong and weak safety points of mission.

- a. Include all info in mission report, including lessons learned.

- b. Hold post-mission evaluation session with all CSSR team members to evaluate all aspects of mission

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- c. Document how to improve specific safety procedures

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- d. Provide treatment for PTSD.

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- e. Replace all worn or deteriorated PPE and safety equipment.

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6. Safety Officer

Definition:

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Function:

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7. Safety Plan

The multi-hazard safety plan is a guide to the basic elements of safety for a variety of incidents. The acronym is **LCES**, which stands for **Lookouts, Communications, Escape Routes, and Safe Zones**. In any operations scenario these areas must be addressed to ensure the safety and accountability of all response team members.

7.1 Lookouts

This is normally the function of the dedicated Safety Officer. That person is the objective observer not involved in the “hands-on” portion of the operation. They are dedicated to watching over the entire operation identifying potentially dangerous situations and mitigating them before they become disastrous.

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Several categories of **Safety Officer** exist:

- **Overall** Safety Officer for the response team.
- **Site-Specific** Safety Officer — may be a person or team assigned to a specific location to monitor the presence of a special hazard. Some examples: one person is designated to stand guard over an electrical box while rescue workers operate in a confined space; or a two-person team is assigned to hike up-slope to serve as early warning for rescuers working below a dam during earthquake aftershocks.
- Safety Officers or Lookouts work from a position of position of safety and clear visual access just outside of the direct work area.
- They must not become involved with the actual “hands-on” portion of the operation. To do so would possibly limit their ability to be that objective observer capable of identifying hazards.
- They should be readily identifiable to all, by their radio designation and by wearing a “Safety Officer” vest or, in a small group, identified during the safety briefing.
- Those tasked with this responsibility must resist the temptation to become involved in the tactical operations themselves. This requires extreme self-discipline. Keep in mind that the success of the mission depends directly upon the ability to counteract hazards before they become problems.

7.2 Communications

The Communications Specialist develops the formal communications plan. This plan will identify the Command, tactical, and special radio channels. These are the operations personnel’s lifeline to the outside for resources, support, and safety. This plan will be provided as part of the Response Team Action Plan.

Remember the Emergency Alert System is to be used in the event of problems at the work site:

| | | |
|-----|-------------------|----------------------------------|
| — | Cease Operations | 1 long blast (3 second duration) |
| — • | Resume Operations | 1 long and 1 short blast |
| ••• | Evacuate | 3 short blasts (1 second each) |

The method of delivery may vary depending upon the device available. Some examples:

- Placing two radios together, speaker to microphone, and depressing the transmit buttons a loud tone is heard on all other radios tuned to that frequency.

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- Air horns, car horns, whistles, the Personal Alert Safety System device and clear text over the radio are all excellent methods for signalling. It is important that during the safety briefing, before beginning to work, identify the specific methods of signalling that will be used at the work site should a problem arise during that operational period.

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7.3 Escape Routes

An escape route is a pre-established path to an area of safe refuge. The safest method of exiting an area may not be the most direct route. Some examples:

- After an earthquake, structural columns may still be standing but subject to collapse during an aftershock.

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- The most direct route to safe refuge may lie directly in the collapse path of the column. The route giving the column a wide distance will be the safest.

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- Another option is to remain in place. If the working area has been shored and leaving this area exposes you to a variety of hazards, stay put.

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The rescue situation is often dynamic, constantly changing. This can occur as a result of external forces or as a result of the rescuer's action. The escape plan should be constantly updated to reflect changes in situation.

- As a new plan is developed, each team member must be made aware of the change in operation. An acknowledgement of understanding must also be received from each team member.

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- If the order is not repeated, the new plan is probably not clear to each member of the team. The result can be injury or death.

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7.4 Safe Zones

Safe zones, also referred to as “safe havens” are the pre-established areas of safe refuge, meaning they are safe from hazards. This could be a designated area outside the hot zone or a safe area agreed upon within the hot zone. If the safe zone is within the hot area, rescuers may have to construct that area around the victim and for the rescuers themselves.

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An example of this would be a victim trapped inside a collapsed structure while rescuers crib and shore the immediate area. In this case, the proper response for rescuers would be to hold their position during an aftershock.

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Part of the Safety Plan should provide for a designated Safe Zone where a team “head count” is taken. This count should be immediately communicated to the next in the chain of command to provide for 100% accountability in the event of an emergency.

8. Safety Briefing

Components of the Safety Briefing

- Chain of Command
- Identifying the Safety Officer
- Safety Plan (LCES)
- Communication plan
- Medical plan
- Rehabilitation plan
- Special hazards
- General safety messages

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6

Search and Location Techniques

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will be able to:

1. Define search and location and describe its importance in the success of a CSSR operation.
2. Describe the composition of a search team and the basic equipment used.
3. List and describe the steps for searching and locating.
4. Define void space and identify probable locations in the four basic collapse patterns.
5. Describe the modes, types and patterns of conducting a search.
6. Demonstrate in two practical exercises the steps for a physical search and location, using two different patterns.

Approximate Duration:

- Lecture: 3 hours
- Practical exercise: 2 hours

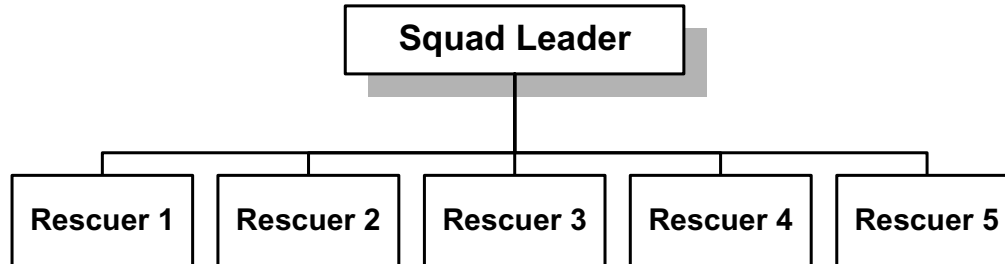




1. Searching and Locating

A set of techniques and procedures whose purpose is to obtain a response or indication of the presence of live victims in a void space within the collapsed structure.

2. Composition of a Search Squad



- **Squad Leader:** Responsible for developing the search plan, drawing diagrams, keeping documentation and making recommendations to the Incident Commander.
- **Squad Leader:** Performs the duties of the Safety Officer and is responsible for monitoring security during the search operation.
- **Searchers:** Physically carry out the search operation as outlined by the team leader.

Basic Equipment Required for Physical Searches

- Complete set of personal protective equipment and emergency medical kit.
- Minimum personal supplies required to function unassisted for at least 12 hours:
 - Drinking water
 - Food
 - Warm clothing
 - Basic tools
- Radio equipment to communicate with team members and Command Post
 - Portable radios (walkie-talkie)



- Building and work site marking supplies
 - Paint
 - Chalk
 - Flags
 - Cones
 - Markers
- Warning and alert devices
 - Megaphone
 - Whistle
 - Flags
 - Hammer
 - Horn
- Reconnaissance and vision
 - Binoculars
 - Photo camera
 - Flashlight
- Search diagrams, pencils, colour pens, clipboards
- Technical search equipment, specialised or improvised
- Additional materials
 - North American Hazardous Materials Response Guide
 - Hazardous Gas Detector

3. Steps for Search and Location

1. Compile and analyse available information.

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2. Secure the scene.

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3. Inspect and evaluate the structure.

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4. Rescue victims with easy access on or near the surface, if this has not already been done.

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5. Make INSARAG markings on the structure as needed, if not already done.

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6. Create a diagram of the structure.

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7. Select the area to be searched.

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8. Select a search method.

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9. Conduct an appropriate search pattern and place INSARAG markings where potential victims are detected, both on the structure and on the diagram.

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10. Continually analyse the results and re-evaluate the search plan (make necessary adjustments).

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11. Initiate pre-hospital treatment of the victim.

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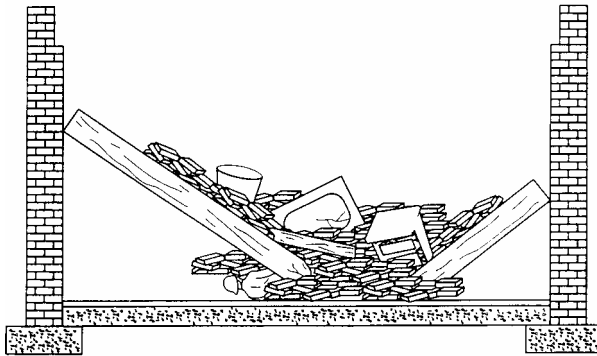
12. Confirm the presence and location of potential victims with the resources and equipment available.



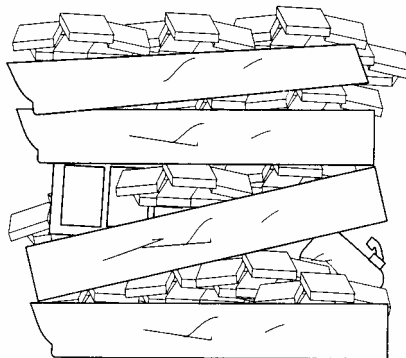
4. Void Spaces

A physical space in a collapsed structure where a person trapped within could remain alive for a short period.

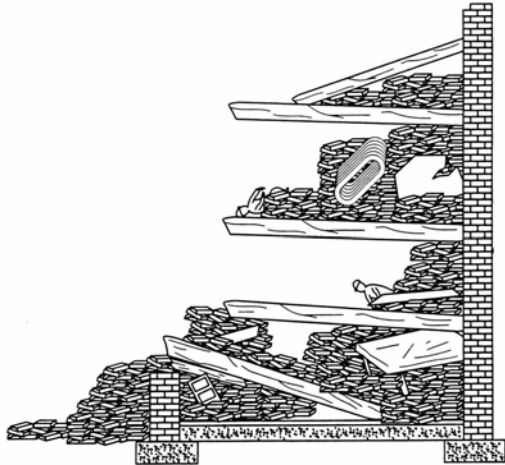
Possible location of void spaces in typical collapse patterns



V-shape collapse



Pancake Collapse



Cantilever collapse

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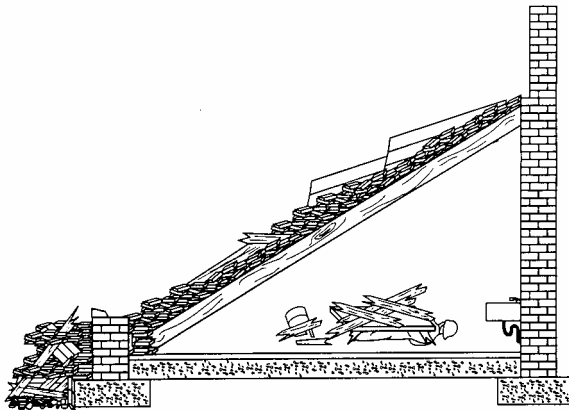
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Lean-to Collapse

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Search Area/Site Sketch

Team # _____ Date: _____ Time: _____ Location/GPS _____ Page: _____ of _____

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |

Legend / Required Symbols

- North arrow
- Scale
- Sides 1, 2, 3 and 4
- Access points:
1st → 2nd →

Chemical

Structural

Environmental

Detected victim

Live victim

Dead victim

Resources Utilized

Physical/
Hailing ☐ Acoustic ☐
Canine ☐ Optical ☐
Other ☐

Cut services:

Electricity

Gas

Water

Command Post

Staging Area

Emergency vehicles

Trucks

Heavy equipment



5. Search Modalities

5.1 Hasty Search (Primary)

This type of search is conducted to quickly detect the presence of survivors on the surface or easily accessible void spaces. Hasty search accomplishes the following:

- Rapid detection of victims
- Scene assessment (information gathered as a result aids in size-up of the rescue problem)
- Sets priorities

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5.2 Extensive (Grid) Search (Secondary)

This type of search is conducted in a methodical manner to pinpoint the exact location of victims. It is designed to cover the entire assigned search area carefully and in detail. An extensive or grid search accomplishes the following:

- A thorough, systematic search
- Redundant checks
- Allows for use of alternate search resources

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This process may need to be repeated as new information is received and/or as the condition of the structure changes.



6. Search Methods

6.1 Physical Search



Physical search operations do not require specialists or unique, expensive equipment. They only require the senses and some established procedures.

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This search tactic is the first, and sometimes the only, search method used by local emergency service agencies that do not possess technical or canine search resources.

Local first responders must rely on fundamental search techniques. A readily accessible and willing group of volunteers can be quickly trained and supervised to safely conduct physical search operations after a disaster. Basic physical search is usually performed immediately after an incident, and may be done by locals.

Physical search includes the three basic tactics:

- Physical/void search
- Hailing
- Basic search patterns

Reminder: These are general tactics. A search team may need to modify and adapt them and the search mode to fit their specific needs.

6.2 Canine Search



Uses the acute sense of smell of dogs specially trained to detect live humans.

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Certified canine teams with highly specialized dogs provide the best way to locate trapped victims in a large area in the shortest amount of time. They are able to access areas too small or too unstable for humans to enter. Canines can be used for hasty and extensive operations.



A thorough site search with two well-qualified search dogs has a high probability of conclusive results. The disaster trained search canine is trained to detect those victims that are still alive. Unless trained to do so, rescuers should not attempt to handle the dogs, but coordinate the activities of those who are trained as handlers.

6.3 Technical Search



Requires highly trained personnel and specialized equipment for sound and temperature detection, video, vibration, etc. Can be carried out using specially manufactured or locally improvised equipment.

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The latest state-of-the-art electronic search equipment has added a new dimension to the search function by extending its range. Whenever possible, dogs and electronic devices should be utilised together. Technical search equipment can be classified into two groups:

- Visual search instruments
- Electronic listening devices

Visual Search Instruments

These instruments can view the exact location and condition of victims buried beneath several feet of debris. The most useful devices are of small diameter, have articulating probes, and incorporate a light source. A large area can quickly be covered with these tools and they are excellent for void searches. Visual search instruments are divided into two main types:

- **Video devices** that transmit images to a monitor
- **Optical instruments** that project the viewed image through fibre-optic bundles or mirrors to a monocular eyepiece

During a hasty search, an operator can quickly assess a site by using existing cracks and openings to search for victims. During extensive/grid search operations success has been shown with rescue personnel drilling a series of holes and an operator following along with visual search equipment to assess the newly accessible void spaces.

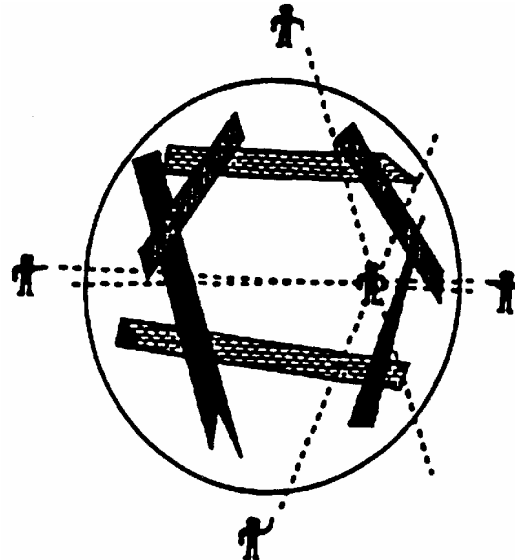


Electronic Listening Devices

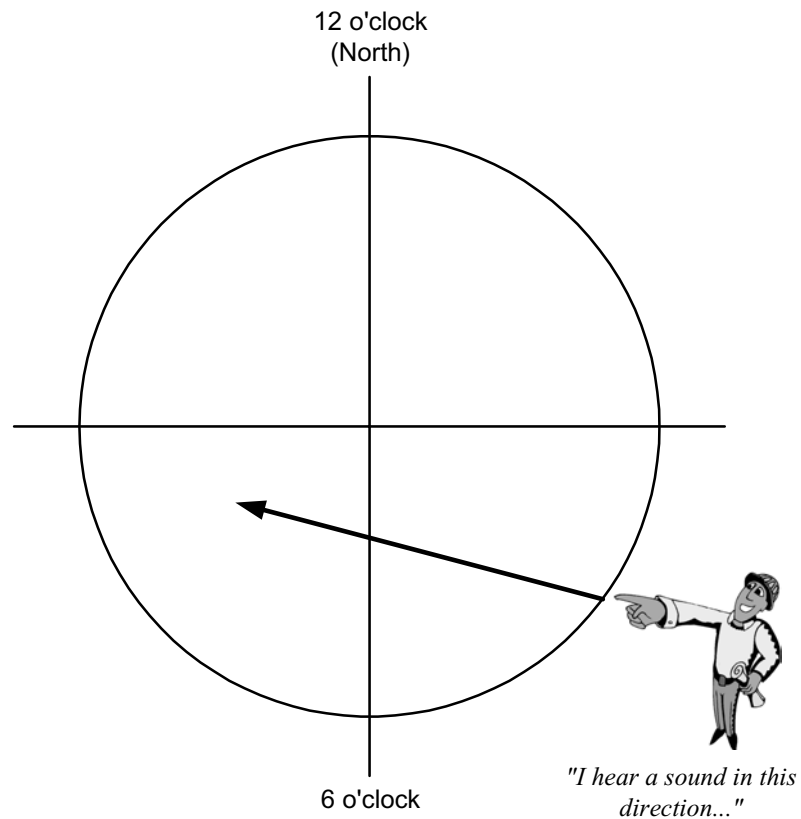
These devices can detect both acoustic sound (such as voice) and inaudible seismic sound (vibrations) produced by survivors deep within a collapsed structure. Although these instruments are capable of filtering a wide range of sound frequencies, they are best used in a noise-free environment. These devices can be used for both hasty search and extensive/grid modalities.

7. Hailing Method Procedure

1. The search team leader signals for silence and all work to stop around the area. Four members of the CSSR team take positions in a cross pattern, positioned at intervals of approximately 8-16 metres in safe locations as close as possible around the search area.
2. Going 'around the clock,' each searcher calls out loudly or with a megaphone, *"If you can hear me call out for help or knock five times on something."* Instead of hailing, searchers may also knock something solid (usually metallic) that is a contiguous part of the site debris in order to elicit a response.
3. All searchers then listen and point in the direction of any potential response to the instructions. If more than one searcher hears the sound, the direction in which they point will triangulate on the source of the sound of the victim. This must be noted on the site sketch or on personal notes, where each rescuer makes a rough sketch of the area and the direction of the source of sound. Use a coordinate grid system and/or the clock system (using North as 12 o'clock).



The collapse pattern, building materials and a multitude of other variables can cause voices to be heard clearer than knocking, and other times vice versa. Use both methods for greater efficiency.



A variation of the hailing system is to set up several searchers in a straight line across the site, or in grid patterns, as when performing the physical/void search. In this scenario, rescuers are also aligned next to, but off, the rubble pile to detect sound the others on the pile may not hear. The rescuers will hail in the order given, listen and then advance as safety permits. This ensures the entire structure is covered in an extensive grid-pattern search.



8. Physical Search Patterns

Occasionally you will encounter structures that have not totally collapsed and contain large, open areas or a building with many intact rooms, in which live victims, unable to remove themselves or communicate, will be found. An organized approach will yield the best opportunity to locate a victim, and to declare the area searched.

8.1 Multiple Rooms

The basic instruction for searching multiple rooms is “**go right, stay right.**”

1. After entering the structure, turn to the right, stay in contact with the right wall, either visually or physically, until the entire accessible area has been searched and the team returns to the starting point.

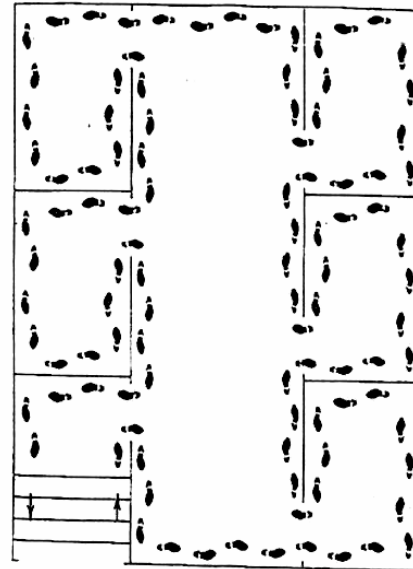
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2. If the search team needs to exit and cannot remember the direction they entered, simply turn around and stay in contact with the same wall, either physically or visually, keeping it on your left.

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8.2 Large Open Areas (Line Search)

Use the line search method in auditoriums, cafeterias, and offices with multiple partitions.

1. Spread search team members in a straight line across the open area, **3 to 4** metres apart.

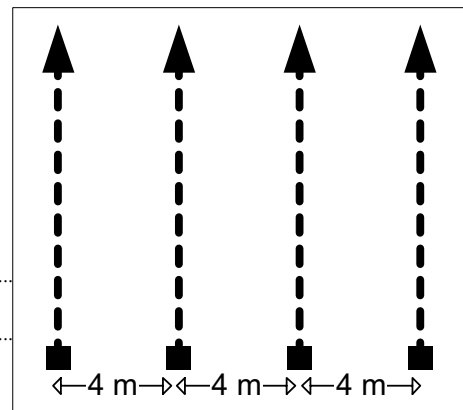
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2. Slowly walk through the entire open area to the other side.

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3. Team members on the ends of the line search perimeter rooms using the go right-stay right method.

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4. The procedure may be repeated in the opposite direction.

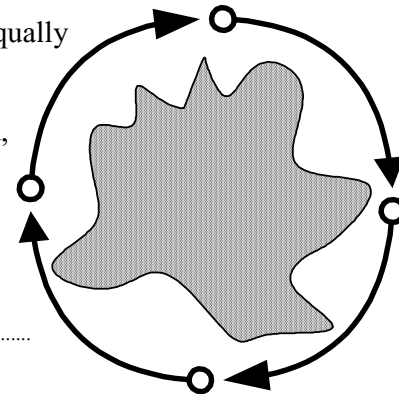
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8.3 Perimeter Search

This search pattern can be used when it is not possible or unsafe to search a rubble pile from on top.

1. Four search team members take positions equally spaced around the search area.
2. After using an appropriate search method, all searchers rotate 90 degrees clockwise. This process can be repeated until all searches complete four rotations (returning to their original positions).



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9. Victim Management

The following concepts and procedures should be applied the moment the search is initiated until the last victim is found.



9.1 Precautions during a search

- Never make inappropriate comments the victim should not hear. Keep your comments on a positive note. Always assume someone is listening to you.
- The victim is in the worst possible position and fighting to stay alive, and you can enhance their chances of survival by being positive about the possibility of finding and extricating them.
- You may be the first person the victim is able to communicate with; therefore it is important to project a sense of confidence and hope.

9.2 Steps for initial contact with a located victim

1. Identify and overcome language barriers.
2. Identify yourself as a rescuer, projecting confidence and calm in your voice and choice of words.
3. Obtain the following information:
 - Name
 - Adult or child (approximate age)
 - Type of injury and extent
 - Hydration status
 - Warmth
 - Degree of confinement



4. Provide emergency medical treatment as quickly as possible.
5. Ask about other potential victims and their condition.
6. Inform the victim of rescue operations.
7. Inform the victim if you have to leave for short periods.
8. Provide protection from the environment as much as possible.
9. Consider direct or indirect intervention of a relative or friend, etc.

10. Improvised Search Equipment

10.1 Acoustic detection (use to amplify sound through a crack or opening in a building)

- Stethoscope
 - Recorder with microphone mounted on a pole
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10.2 Visual detection

- Telescopic mirror with illumination
 - Common video camera
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10.3 Sound transmission

- Loudspeaker mounted on an extension, with microphone
 - Portable radios
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10.4 Other

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| Collapsed Structure Search Data Form | | |
|---|---|---------------------|
| Date: | CSSR Team Identification: | |
| Time: | Name or description of structure: | |
| Date of collapse: | Approximate occupancy at time of collapse: | |
| Time of collapse: | Location of structure: | |
| Occupancy type at time of collapse <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Residential <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial </div> <div style="margin-top: 5px;"> <input type="checkbox"/> Other / describe: _____ </div> | | |
| Structural Type: <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Light Frame <input type="checkbox"/> Pre-Fab/Tilt-Up Concrete </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Heavy Wall <input type="checkbox"/> Heavy Floor </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> # Floors _____ # Columns _____ Blueprint or photo available? _____ </div> | | |
| Structural Engineer Assessment Name: _____ Identification: _____ Condition of Structure: _____ _____ _____ <div style="text-align: center; margin-top: 10px;"> Cut off services: <input type="checkbox"/> Water <input type="checkbox"/> Electricity <input type="checkbox"/> Gas </div> | | |
| Rescue Information (see rescue victim identification form) <div style="display: flex; justify-content: space-between;"> # Rescued _____ # Bodies recovered _____ </div> | | |
| PREVIOUS RESCUE TEAM EFFORTS | | |
| Team Name / Id | Leader's Name | Contact Information |
| | | |
| | | |
| | | |
| | | |
| | | |

**Relatives, Neighbours, Witnesses, Residents
or Building Personnel with Possible
Information on Trapped Victims**

| Full Name | Association to Structure | Location | Information |
|-----------|-----------------------------|----------|-------------|
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Victim Identification Form

Rescued Victims

| FULL NAME OF VICTIM OR OTHER IDENTIFYING INFORMATION | DATE | TIME | PLACE | RESCUER'S IDENTITY |
|--|------|------|-------|-----------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Recovered Bodies

| FULL NAME OF VICTIM OR OTHER IDENTIFYING INFORMATION | DATE | TIME | PLACE | RESCUER'S IDENTITY |
|--|------|------|-------|-----------------------|
| | | | | |
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Structure Information Form

(ATTACH THIS FORM TO THE SITE SKETCH FORM.)

POTENTIAL DANGERS PRESENT

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CONFIRMED DANGERS

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PERSONNEL AVAILABLE FOR SEARCHING

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EQUIPMENT AVAILABLE

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